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Baron von Weber's Experiments on the Stability of Permanent Way.

[CONTINUED FROM PAGE 366.]

Notwithstanding the great value of the results obtained from the experiments we have already described, it is undeniable that some of the main questions relating to the stability of permanent way structures, can only be finally answered by ascertaining the amount of the momentary deflections and displacements of the rails which actually occur when a line is subjected to the action of passing trains, but which disappear entirely, or almost entirely, after the action which causes them ceases, and which are thus, under ordinary circumstances, likely to escape observation.

The momentary deflections and displacements just referred to may be divided into two classes, those which apparently disappear on the removal of the load, and those which disappear absolutely. To the first class belong those deflections and displacements which, although causing a greater or less loosening of the structure, are yet within the limits of elasticity of the rails, so that the latter, after the passage of a train, return to their normal positions, and there are only left to mark the movements which have taken place, the small lateral displacements of the spikes, or small impressions of the sleepers by the bases of the rails. Such marks of displacements are likely to escape any but very careful inspection; yet, taken altogether, they may allow to the rails an amount of play or liberty to cant, which may produce dangerous results.

The second class of momentary displacements, on the other hand, consist of those which take place within the limit of the permanent way structure as a whole, all the parts returning to their normal positions on the removal of the cause of the disturbance. Such momentary alterations as these in the positions of the rails occur less frequently than those of the former class, but they nevertheless become dangerous under certain circumstances, which will be spoken of hereafter.

The observation of the momentary alterations in the positions of the rails which occur during the passage of trains is a difficult matter, but still more difficult is it to ascertain correctly the amounts of the various movements which take place. Thus, first, the action of the rolling stock produces sudden shocks and blows, which preclude the employment of any arrangement of levers for measuring the acting forces; next, the movements of the rails are so complicated that the use of arrangements or apparatus which should simultaneously indicate accurately all these movements would be almost impracticable, and, finally, it is extremely improbable that the maximum deviation of the structure under its loads should take place just at the moment of observation, and yet this maximum movement is the very thing which it is desired to ascertain. To overcome these difficulties of observation, Baron von Weber designed an admirably simple arrangement, which answered its purpose perfectly, and of which we shall give a description shortly.

Before describing his own experiments, Baron von Weber gives an account, at some length, of those carried out in this country by Mr. Peter Barlow in 1835. Mr. Barlow employed for his observations the instruments illustrated by us on page 253 of the present volume,* these instruments, however, being open to several important objections, as we have already explained. It was, in fact, probably owing to these defects that many of the discrepancies in Mr. Barlow's experiments are due. We shall not, however, speak further of Mr. Barlow's experiments here, but shall proceed to give an account of those carried out by Baron von Weber.

In the first place, Baron von Weber desired to measure merely some vertical deflections of the rails under the influence of the traffic, and for this purpose he employed the simple arrangement used by him for measuring the compressibility of the sleepers, and illustrated by us on page 344† of the present volume.

44th Series of Experiments. The vertical deflection of the rails of variously constructed permanent ways was determined under the passage of an engine weighing 550 centners (=62,392 lbs.), the greatest load upon one wheel being 110 centners (=12,478 lbs.), and the experiments being made on a straight portion of the line. The deflections were measured at the middle of the rails, at those parts of the lengths of line at which the sleepers appeared to be firmly bedded in the ground. Table No. 1 contains the results of these experiments.

The experiments 1 to 7 were, as is recorded in the table, made with structures, the rails of which were of the section illustrated by us on page 307‡ of the present volume, while the seven sleepers to which each 18 ft. rail was attached, had a bearing surface on the ground of almost exactly 3.5 square meters (=36.58 square feet) and the average deflection of rails between two intermediate sleepers amounted to 5.8 millimeters (=0.228 in.). This deflection, however, included the deflection of the rail itself, the compression of the sleepers, and the impression of the latter into the ballast; and these various amounts would, according to the results of preceding experiments, probably be distributed as follows:

	mil.	in.
Impression of the sleepers into the ballast	1.3	0.051
Deflection of the rail	1.3	0.051
Compression of the sleepers	3.4	0.134

These values remained the same for all speeds at which the engine was run over the structures.

Baron von Weber justly considers that the conclusions to be drawn from the above experiments are of importance, as they give numerical values for a considerable proportion of the resistance which has to be overcome by the rolling vehicles. Even if the impression of the sleepers into the ground could be attributed to an insufficient bedding, there still remain the deflection of the rails and the compression of the sleepers to absorb power, and Baron von Weber considers that this power amounts for each wheel, to the weight on that wheel multiplied by the deflection of the rail multiplied by the velocity of the engine. Taking the deflection of the heavier structure as 4.5 millimeters (=0.018 ft.) and that of the lighter structure as 6 millimeters (=0.02 ft.); and the weight per wheel as 110 centners (=12,478 lbs.), we should get the power consumed as being in the case of the heavier structure:

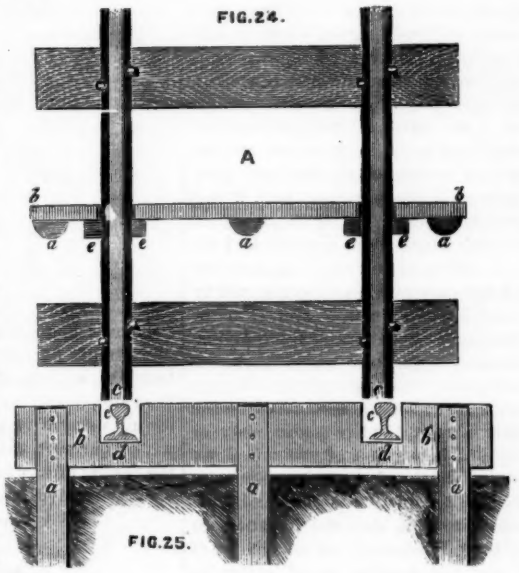
$$P = 12{,}478 \times 0.018 \times V;$$

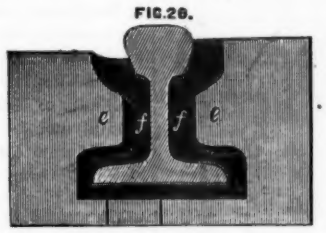
and in the case of the lighter structure,

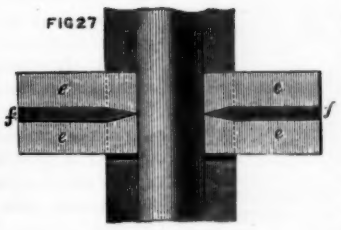
$$P = 12{,}478 \times 0.02 \times V,$$

P in these equations being the power consumed in foot-pounds, and V representing the velocity of the engine in feet, per minute. Baron von Weber calculates in this way that in the case of the engine weighing 550 centners (110 centners on each of four wheels, and 55 centners on each of the other two) the power thus consumed, when running at a speed of 5 miles per hour, amounts to 17.15 effective horse power on the more rigid, and 23.3 horse power on the lighter structure, and he considers also that this power increases in direct proportion to the speed and weight of the engine. He states, therefore, that by making a few experiments the influence of any permanent way structure on the resistance opposed to the passage of the trains, and consequently on the consumption of fuel of the engine, can be ascertained.

The importance of the results obtained by observations of the deflections of the rails caused by the single







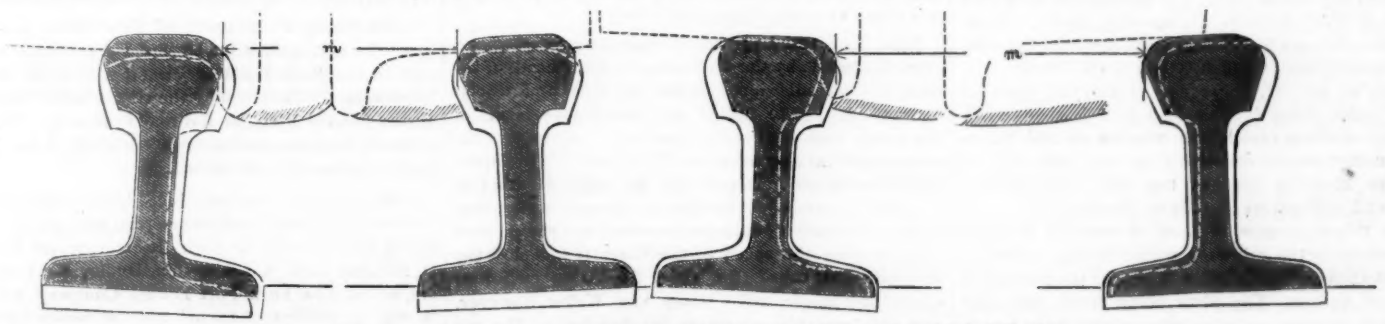


Diagram Showing the Displacement of Rails under Traffic—One-third full size.

* Page 148, Vol. II.; † Page 244, Vol. II., RAILROAD GAZETTE.

‡ Page 196, Vol. II., RAILROAD GAZETTE.

passage of an engine made it the more desirable to ascertain by other experiments the extent of all combined movements of the rails at different points of the structure under various circumstances, and during a considerable length of time. These experiments could, however, only give satisfactory results, if they were made not only on straight and horizontal portions of the line, but also on curves of different radii traversed by trains at various speeds. But the construction and fixing of apparatus as well as the carrying on of continual observations at so many different points was practically almost impossible, and it thus became necessary to devise means by which the whole movements of the rails at any desired points could be registered mechanically.

TABLE No. 1.—SHOWING THE DEFLECTION OF THE RAILS IN VARIOUS PERMANENT WAY STRUCTURES WHEN TRAVERSED BY AN ENGINE WEIGHING 550 CENTNERS (=62,392 LB.), AND HAVING A MAXIMUM LOAD OF 110 CENTNERS (=12,478 LB.) ON A WHEEL.

Number of Experiments	Description of Structure and Rails.*	Distance apart of sleepers from center to center.	Width of sleepers.	Greatest Deflection of Rails
	Experiment on the main line of the Silesian Railway—Iron rails	mil. in. 1,042—41.0	mil. in. 229— 9.05	mil. in. 5. —0.197
1	" " " Steel rails	902—35.5	300—11.84	4.5—6.477
2	" " " "		300— 7.87	
3	" " " "	813—32.0	300— 7.87	6.5—0.256
4	" " " "		250— 9.15	
5	" Bohemian Railway—Iron rails	1,042—41.	300— 7.87	6.5—0.256
6	" " " "	1,016—40.1	225— 9.15	5.5—0.216
7	" Silesian Railway—Steel rails	1,074—41.5	260— 9.84	6.5—0.256
8	" " " "		300— 7.87	
9	" " " "	1,054—41.5	250— 9.84	6.0—0.236
10	" sidings of the Bohemian Railway—Iron rails,		300— 7.87	
11	" " " shallow section	1,042—41.0	190— 7.48	7.2—0.283
12	" " " "	1,043—41.0	190— 7.48	8.5—0.335
	" " " "	1,168—46.0	190— 7.48	10.0—0.394
	" Silesian Railway	1,080—42.5	230— 9.05	8.5—0.335
	" " "	990—38.9	210— 8.27	8.5—0.335

* In all cases when not otherwise specified the section of rails used is that illustrated by us on page 307 of the present volume. (Page 196 RAILROAD GAZETTE.)

The arrangement designed by Baron von Weber for fulfilling this end was, as we have observed, admirably simple, and of very cheap construction. It consists, as shown by Figs. 24 and 25, of three stakes or piles, *a a a*, driven into the ground for a depth of about 5 ft., these piles carrying across piece, *b b*, having cut in it two notches in which the rails, *c c*, can play freely. To the cross piece, *b b*, are fastened at *d* and *d*, where the rails pass through, the wooden cheeks are blocks, *e e*, *e e*, Figs. 26 and 27, these cheeks carrying between them a leaden plate, *f*. This lead plate is about 6 millimeters (=0.236 in.) thick, and consists of two halves fitted exactly to the section of the rail, the edge of the plate where it touches the rail being thinned down to 1.5 millimeters (=0.059 in.) in thickness.

When this apparatus is fixed in position the lead plate surrounds the rail everywhere, except at the top and at the point where a space is left for the passage of the wheel flanges. The plate being fixed, and held securely in its place entirely independent of the rail, it follows that any movements of the latter which take place must cause a forcing away of the edges of the lead plate, and thus the outline of the hole in the latter at the end of any given time gives a correct indication of the maximum movements of the rails in every direction which have taken place since the lead plate was fixed.

Baron von Weber has published a number of interesting diagrams showing the movements of rails ascertained in this way; and from these we have selected two, and have them carefully reproduced, one-third full size, on the preceding page. The annexed table (No. 2,) gives a summary of Baron von Weber's observations on the movements of the rails carried out by means of the apparatus we have described, on various parts of the lines mentioned, and during ordinary traffic. It may be added that during the time the experiments were being carried on, the weather was for the most part favorable, no soaking of the ground taking place, while the gauges were always fixed at points where the structure was firmly bedded.

This table, in connection with the diagrams, is very instructive, and it explains in a simple manner the causes for many accidents which, if it were not for the movements of the rails being thus registered, would not be set down to the condition of the permanent way or the rolling stock, but the causes of which would remain more or less of a mystery. Instances of this are to be found in the running of engines and trains off the rails at straight and well-maintained portions of the line, when moving at a moderate speed, and with the wheels and axles in good condition.

The diagrams and the dimensions given in the table show that the momentary displacements of the head of the rail may amount to 7 millimeters (=0.275 in.) on the inside of a curve, and 8 millimeters (=0.315 in.) on the outside. It is, Baron von Weber remarks, further admissible that the flanges of the wheels may become so worn before the tires are re-turned that the lateral play on a line of the normal gauge of 1,436 meters (=4 ft. 8½ in.) may amount to one inch each way from a central position, and, moreover, on sharp curves it is not unusual to widen the gauge to the same extent, namely, 1 in. The normal distance between the tires on the German railways is 1.36 meters (=4 ft. 5½ in.), and, with the tires worn in the manner above referred, the combined thickness of the two flanges where they press against the rails would be reduced to, say, 21 millimeters, making the distance from outside to outside of flanges at these points 1,381 meters. But there are a great number of wheels still running on German railways having tires but 113 millimeters (=4½ in.) wide, and thus adding together the distance between tires, thickness of flanges and width of one tire, we get a total amount of 1.36+0.021+0.113=1.494 meters. Now, if wheels of this kind are on a portion of the line laid to the gauge of 1.461 meters, which we have mentioned as being employed on sharp curves, and if this gauge has been momentarily enlarged by displacement to the extent of 15 millimeters, thus making it 1.476 meters; then, with the flange of one wheel against one rail, the other wheel will only overlap the other rail by 18 millimeters, or but 0.7 in. This may appear to be an exaggerated supposition; but the annexed diagram, *B*, proves that on the part of the line where that diagram was taken, such a state of things had actually occurred. But the heads of the rails are rounded at the sides, and as the outer edge of the tire is also more or less rounded, the real bearing surface of one wheel on the rail is reduced to a width of 4 or 5 millimeters (=0.157 or 0.196 in.), and it is easy to understand how a very slight extra displacement, due, for instance, to the slippery state of the rail reducing the coefficient of friction between it and the wheels, would suffice to cause the latter to slip down between the rails, thus causing an accident. Baron von Weber justly remarks that the extent of this generally unrecognized danger is exceedingly disquieting, and its existence points strongly to the necessity of maintaining the permanent way in good order, and avoiding the use of tires of a less width than 125 millimeters (5 in.)

Table No. 1, and diagrams given on the previous page, show distinctly, by the displacement of the heads of the rails, how the adhesion between the rails and wheels cause the former to follow the lateral movements of the latter; and the table, moreover, proves by the almost uniform displacement of the two rails in curves both inwards and outwards that the superelevation of the exterior rail is just as often the cause of an increase as of a diminution of the resistance of the engine and train, as when the speed of the latter is too slow the superelevation causes the wheel flanges to be forced against the inside rail. Baron von Weber, however, does not deem this any reason for abandoning the use of superelevation for the outer rail of curves; but on the contrary he considers that, notwithstanding the defect just mentioned, it is one of the best safe-guards which can be adopted for preventing excessive displacements of the structure.

In concluding our account of this portion of Baron von Weber's investigations, we cannot refrain from directing the attention of engineers in this country and abroad to the important information which might be obtained, at very little trouble and expense, by the general use of the method of gauging the movements of rails by the employment of lead plates in the manner we have described. Baron von Weber's experiments were made on permanent way structures of a somewhat light class, and it would be exceedingly interesting to know how far the movements of the rails of which he obtained records exceed those which take place in the heavier permanent ways in use in this country. It would also be interesting to know the different extents to which any given class of permanent way is displaced by engines and rolling stock of different classes; and by making trials of this kind much valuable information might be gained as to the effect on the permanent way of engines with or without bogies, of different wheel bases, and with different distributions of weight.

TABLE No. 2.—SHOWING THE DISPLACEMENTS OF THE RAILS DURING THE PASSAGE OF TRAINS.

Line of Railway.	Incline.	Curves—Radius in meters.	Gauge in meters.	Total deflection of rails in millimeters.	Horizontal displacements of the head of rail in millimeters.		Horizontal displacements of the base of rails in millimeters.		Reference to diagrams...
				right. left.	right.	left.	right.	left.	
					—9		—9		A.
Saxon Bohemian Railway..	1 in 2000	str'ght line.	1.432	7 8.5	+9 —9	+4 —1			
" " "	1 in 2000	....	1.438	8 1	+3.5—3.5	+4 —7	—0.5+1	+1 —3	
Saxon Silesian Railway.....	1 in 140	....	1.439	8.5 7.1	+7 —3.5	+9—3.5	+8 —1	+1 —3.5	
" " "	1 in 140	....	1.436	8.5 7.5	+7 —0.5	+3 —3	+8 —3.5	+3 —3.5	
" " "	1 in 135	....	1.436	6 10	+4.5—1.95	+9.7—3	+9 —0	+4 —1.5	
" " "	1 in ?	151	1.444	5.5 4.25	+2 —0.5	+7 —1	+1 —0	+6 —1.5	
Dresden-Chemnitz Railway.	1 in 100	849.37	1.466	4.5 6	+6 —3	+6 —1.9	+3.5—1.5	+5 —1.5	B.
" " "	1 in 100	986.66	1.466	6 5.5	+6 —3	+1 —1.3	+3 —3.5	+3 —1.5	
" " "	1 in 100	989.19	1.465	6 5.5	+2 —0	+8 —1.5	+8 —1.5	+1.25—3	
" " "	1 in 40	989.19	1.465	8.5 8.5	+6.5—0.5	+4 —5	+2.5—0	+9 —3	
" " "	1 in 100	169.31	1.462	8.5 9.5	+6.5—0.5	+4 —8	+2.5—0	+3 —3	
" " "	1 in 70	169.31	1.466	5.5 6	+4.5—0	+4.5—2	+8 —1.5	+2.5—1.5	

NOTE.—The horizontal displacements towards the insides are marked —; those towards the outside, +

There are hundreds of our readers who have ample opportunity for carrying out such experiments as those to which we have alluded, and the apparatus required is so simple and inexpensive that there is little excuse for not using it very extensively. We may add that we, on our part, shall be happy to give full publicity to the results of any investigations of this kind of which we may receive the necessary particulars.—*Engineering.*

[TO BE CONTINUED.]

MISCELLANEOUS.

—The Montreal Rolling Mills Company has declared a dividend of 10 per cent., and carried a large sum to the rest fund. Peter Redpath was elected President, and Mr. C. S. Watson, Vice-President; and Messrs. E. H. King, Geo. Stephens, and W. M. Molson, Directors.

—Mr. George F. Bicknell, of New York, has commenced a suit against the city of Port Huron, Michigan, in the United States Circuit Court, to recover interest on bonds issued by the city in aid of the Port Huron & Lake Michigan Railroad Company. This will probably be a test case as to the validity of the Michigan Supreme Court decision.

—Mr. Conkling has introduced into the Senate a bill to provide for additional commercial and postal facilities in the port of New York. It incorporates Marshall O. Roberts, John A. Livingston, Dudley Field and others, as the New York Port Tunnel Company, with authority to construct a tunnel, tube, or covered way, in or beneath and across the beds of the bay of New York and Hudson River, from some point in New York city to some point in New Jersey, opposite, and a similar tunnel from New York to Brooklyn. The company is also empowered to operate railroads in said tunnels. Referred.

—The Dominion Telegraph Company of Canada during 1870 constructed 327 miles of line between Montreal and Oshawa, 59 miles between Prescott and Ottawa, 78 miles between Houghton and London, and 18 miles along the Totonto, Grey & Bruce Railway, a total of 482 miles, with 147 miles possessed by it the previous year, gives it a total mileage of 629 miles of poles on which there is 1,116 miles of wire, with 35 offices open. Further extensions are to be made as soon as possible from London to Windsor, and from Toronto *via* Guelph, Stratford and St. Mary's to London. The company has $84,210 of capital stock paid in, and an indebtedness of $2,513.45. The President is Hon. John Murrich; Vice President, J. J. McKenzie; Treasurer, James Michie.

Contributions.

SIMPLE RULES FOR LOCOMOTIVE ENGINEERS AND MACHINISTS.

There are many simple rules for estimating mechanical conditions or mechanical results which are of great value in assisting the judgment of the engineer and machinist. The *power* of an engine, for instance, is, under known conditions, as much a matter of *measurement* as a cord of wood or a gallon of water. So is the gravity of a train on a down grade, that is, the force with which it tends to descend.

THE POWER OF THE LOCOMOTIVE.

If the wheels of a locomotive were *geared* into toothed rails, we should say that its power was the force with which its wheels could be made to turn, or the weight or force which, applied at the rims of the wheels, would prevent them from turning. But if, in another case, where the wheels revolved upon ordinary smooth rails, the wheels would often *slip* in turning, thereby wasting a part of the "power," we should say that the effective power of the engine was limited by the *friction* or *adhesion* of its driving wheels. Hence the terms *tractive power* and *adhesive power* are proper, the first meaning the revolving power, the second the progressive power of the engine.

Rule for Calculating the Tractive Power of the Engine.—Multiply the diameter of the cylinder, in inches, by itself; multiply the product by the effective pressure of steam on the piston, in pounds per square inch, (estimated or measured); multiply this last product by the length of stroke in inches, and divide the whole by the diameter of the driver in inches. The quotient is the power with which the wheels revolve, or the tractive power of the engine. A weight equal to the quotient, if hung upon the rim of one of the driving wheels, or one-half the quotient hung upon each of the two drivers, would prevent them from turning with the assumed pressure of steam.

Seventy-five pounds per square inch of piston is about the pressure of steam which can be safely calculated in reckoning the full power of an engine, although it is of course possible to use higher steam.

Example.—What is the tractive power of an engine with 16-inch cylinders, 75 lbs. of steam, 22 inches stroke, and 54 inch drivers?

16 inches diam. of cylinder.
16

256 square of diameter.
75 lbs. per square inch.

19,200
22 inches, length of stroke.

54)422,400(7,822 lbs.=Answer.

To know the power of the engine to draw a required load in tons, we must know the resistance of each ton. This varies with the speed of the train, etc. On a level road, at a slow speed, the friction and concussions of loaded trains are from 7½ to 11 pounds per ton of train.

With a resistance of 10 pounds per ton, the above engine would draw 782 tons on a level, equal to about 49 cars, weighing, loaded, 16 tons each.

It is evident that unless the *friction or adhesion* of the drivers upon the rails is equal to the tractive power, the latter can never be fully and usefully exerted. It is necessary, then, to know the amount of the adhesion which can be calculated upon under ordinary circumstances.

The adhesion under the best circumstances, with dry, clean rails, is about *one-fifth* of the weight pressed by the driving wheels upon the rails. Cases are, however, known, in which this limit has even been exceeded.

But from *one-fifth* the adhesion is often reduced by wet or greasy rails to less than *one-twelfth* of the weight on the drivers. Probably *one-sixth* may be taken as the average ordinary effect. Having first determined the tractive power, we are thus prepared to learn what weight an engine should have upon its drivers in order to make that power available. The engine assumed, for the example, had 7,822 lbs. of tractive power. Hence, six times the sum should be the least weight on the drivers. This would be 46,932 lbs., or about 23½ tons. This would be about the entire weight of the engine in running order; hence the *whole* weight should be upon the drivers. It would be a gross blunder to proportion an engine with 16 by 22-inch cylinders, and 54-inch drivers—weighing 24 tons—and to place one-third or one-half this weight on a *truck*. If a truck is required, the weight on the drivers should be increased, or the cylinders diminished in size, or the driving wheel enlarged in diameter. There should be an equilibrium between tractive and adhesive power.

RESISTANCES OF TRAINS.

The resistances of trains are considered to be divisible under four heads, viz: Friction of wheels and axles; concussion of wheels against the rails; atmospheric resistance, and gravity.

The first resistance is considered to be constant at all velocities, and as being from 6 to 10 lbs. per ton of the load drawn, according to the perfection of the cars. Thus, a loaded car weighing 16 tons would require a horizontal pull of from 96 to 160 lbs. to move it slowly on a level.

The second resistance is considered to increase directly with the velocity, and as being ⅛ lbs. per ton, at one mile an hour, or equal to 3⅓ lbs. at ten miles, and to 10 lbs. at thirty miles an hour. The resistance of the atmosphere increases with the square of the velocity, and is about 1-6 lb. for the front of an ordinary train at one mile an hour, 16⅔ pounds at ten miles an hour, and 600 lbs. at sixty miles an hour.

The resistance of gravity is .3787 of a pound per ton of 2,000 lbs., on a grade of one foot per mile. It is .4242 of a pound per ton of 2,240 lbs. also on a grade of one foot per mile. It increases directly with the steepness of the grade.

Examples.—What is the resistance of a train of 60 tons, (of 2,000 lbs.) running 30 miles an hour, on a 40 feet grade?

Friction, 60 tons by, say 8, pounds per ton	480 pounds.
Concussions, 60 tons by 30 miles by ⅛	600 "
Atmosphere, the square of 30, being 900, by 1-6	150 "
Gravity, 60 tons by 40 feet by .3787	909 "
Total, equal to 35¾ pounds per ton	2,139 "

If we have an engine capable of exerting a constant force (above its own weight,) of 6,000 pounds, what number of tons would it draw, at 60 miles an hour, on a 30 feet grade?

The atmospheric resistance of the *train* at 60 miles an hour being (60×60×1-6) 600 lbs., this taken from the whole power leaves 5,400 lbs. of power for friction, concussions and gravity.

The friction per ton is, say	8 pounds.
Concussions " " 60×⅛	30 "
Gravity " " .3787×30	11.36 "
Combined resistances are	39.36 "

Calling the sum 40 pounds, 5,400 pounds will draw 135 tons.

The measures of the different resistances are derived from the most careful experiments made in England, and have been analyzed and classified by the most distinguished engineers. The resistance of gravity is ascertained by dividing the length of the grade by its height, the quotient being the number of times the gravity is contained in the weight of the load. A mile being 5,280 feet, the gravity on a grade of 40 feet per mile would be (5,280 divided by 40=132) 1-132 of the weight, or 15.15 pounds per ton of 2,000 pounds. The gravity of one ton on a grade of one foot per mile is (2,000 divided by 5,280) .3787 pounds, as given above.

F.

Report of the Massachusetts Railroad Commissioners.

[CONCLUDED FROM PAGE 388.]

These questions were somewhat considered during the session of the last Legislature. A law was passed declaratory of the general right of the Legislature to regulate at its discretion all tariffs of fares and freights on the several railroads of the Commonwealth, without regard to the amount of net earnings. The commissioners are unable to see how any satisfactory results can be arrived at through action under this law. The grounds on which they base this impression can be stated in very few words. All legislation in the direction indicated must be either general or special—general as applying to all the railroads of the Commonwealth, or special as applying to some individual one of them. No general law of this nature has yet been framed adequate to meet the wants of the case, though attempts at it have frequently been made; nor, indeed, do the commissioners now see how such a law could be framed. Not that it is here meant to imply that the regulation of railroads by law is impracticable, but the doubt is confined to their regulation in this particular way. Other methods have been and hereafter will be suggested, and their practical merits can only be ascertained after trial; this method has, however, repeatedly been tried, and with a uniform result. The cause of failure in this case is indeed most apparent. A general law regulating fares and freights, which would very slightly touch one road, would inevitably ruin another; a tariff which would apply to one class of articles would be simply ridiculous when applied to another. The law found generally on the statute books provides a maximum per mile for each passenger and for each ton of freight. A law on this principle framed to meet the case of the Boston & Albany road, by materially reducing its present rates, whatever result it might produce on that company would speedily send the Housatonic road into insolvency;—a law which permitted the Housatonic to earn a dividend would have no application to the Boston & Albany. So of descriptions of freight: a rate per ton per mile applicable to coal or pig iron would produce results eminently unsatisfactory to the corporations if applied to feathers, wicker-work wooden-ware or household furniture. It is, however, useless to discuss this question;—a general law which shall meet the circumstances of all the separate roads and provide for all classes of freights, degrees of speed and arrangements for comfort is a practical impossibility. It may, however, be urged that the law of 1870, (chap. 325, § 1) was intended to pave a way for special legislation to meet individual cases. This is very probably the case; at the same time, should the Legislature undertake to follow out the plan indicated, and to specifically regulate the tariffs of each railroad of the Commonwealth, according to its particular circumstances or the needs of its surrounding community, it will launch itself into an ocean of special legislation such as has never yet been attempted, and no large legislative body could successfully attend to. Should it delegate a power in this regard to the present or any other board of commissioners, it would simply destroy it by so doing. A responsibility would be imposed unsustained by any executive power. An authority to regulate fares and freights over roads owned, controlled and operated by others, would place those in whom such authority was reposed in an entirely false and impossible position. Those managing the roads could produce what results they saw fit; they could easily demonstrate, by apparent practical workings, the absurdity of anything which was distasteful to them. They could reduce to real failures the most correctly reasoned theories. It is useless for the Legislature to look for satisfactory results from the labors of any board which can only work through reluctant agents, and the position of one who can direct but cannot execute is in the last degree unfortunate. It resembles nothing so much as that of a military commander, all of whose subordinates feel a direct and lively interest in his failure.

For these reasons, the commissioners do not believe that the desired relief lies in the direction towards which the legislation of last winter pointed. They believe it does lie in a directly opposite direction. The course they would recommend is the following: let the State adopt its own plan of railroad management, wholly independent of the private railroad corporations—how this plan should, in the opinion of the commissioners, be developed, will be set forth in the subsequent part of this report—having done this in such a manner as to commit itself to the least possible expense consistent with a perfect trial of a great experiment, recognizing it simply as a tentative effort, let the State then give the existing corporations distinctly to understand that the continuance of their corporate existence depends wholly on (1) the results of the experiment in operation; (2) on their own success in the process of competitive development side by side with it. All restraints should then be removed from the private corporations; they should be allowed, within the limits of the law, to freely follow their own devices; the two systems would thus be compelled to work their way out in visible and perfect contrast, and that which, at the expiration of a reasonable term of years, should prove itself to be best, would undoubtedly be adopted with general acquiescence. The corporations, however, should not hereafter have it to say that they were trammelled or tied down during the period of trial; the principle of private corporate management should have full play, while it distinctly understands that it is on probation.

Whether the corporations should hereafter meet more fully the expectations of the community, or should fail to do so, the commissioners would recommend that the State should be prepared to take its own course. The commissioners do not propose in this connection to discuss the question of state ownership of railroads. There are arguments, based both upon theory and experience, in favor of it and opposed to it. In this country it has not hitherto been attempted with success; but it is not clear that failure did not arise from the effort both to construct railroads and to originate a system of operating them; nor, indeed, was failure confined to public enterprises, as it is matter of notoriety that all the early railroad undertakings in private hands passed through long periods of extreme depression and financial tribulation. There are also very grave political considerations involved. The principle upon which our government is founded, that of least possible governmental interference and largest possible individual development, has a strong hold on the popular mind. The public opinion of the Commonwealth unquestionably accepts with great reluctance any measure calculated to bring industrial enterprises within the influence of politics. At the same time, a strong and growing popular conviction cannot be ignored, that railroads and internal communication constitute an exception to this general rule. The success which has attended an opposite policy in Belgium, and the experiments now in progress in Great Britain, have by no means escaped notice. The political considerations involved do not, however, fall within the province of this board; it is for the commissioners simply to recommend that course which is, in their opinion, best calculated to certainly and safely reduce the transportation tax; and it is for the people and their direct representatives to decide whether the advantages likely to flow from that policy are or are not sufficient to counterbalanced by the dangers to our political system involved in it. The problem before the commissioners is a purely material one, and it is for another tribunal to weigh ulterior and political considerations. The commissioners do not, therefore, propose to argue these questions or to commit themselves to any opinions in regard to them. Neither, on the other hand, are they disposed to recommend anything rash or sweeping; but, while they do not wish to destroy the old until the new is established, the new can only be pronounced either a success or a failure after a fair course of experiment. There is nothing to prevent private ownership and state ownership of railroads from existing at the same time in the same community. They have always existed and still do so exist in Belgium. According to the statement of M. Fassiaux, at the time Belgian Director-General of Posts, Railways and Telegraphs, made to the British Royal Commission on Railways of 1868.* there were, on January 1st, 1864, 1,247 miles of railway in Belgium. Of this amount, 347 miles

* Minutes of Evidence, Qu. 3,058; also, Appendix M.

had been constructed and were worked by the State, belonging to it without reserve. The State derived the profit or suffered the loss (as the case might be) resulting from the working. In addition to this, 117 miles constructed by private companies and worked by the State, were likewise the property of the State, though a proportion of receipts was paid over to the companies who constructed the roads, as the remuneration for work done. The remaining 780 miles were both constructed and worked by private companies, free from public control. The practical operation of the mixed system of ownership thus existing in Belgium might reasonably be expected to somewhat reproduce itself in Massachusetts. Of it M. Fassiaux said in the examination already referred to, "the State railways thus (through a mixed system of ownership) find themselves placed in constant comparison with the railways worked by private companies; on the one hand stimulating them to general improvements, and on the other hand acting as a sort of a check against any attempt to realize extravagant profits at the expense of the public." These are the identical effects which the commissioners desire to see produced in Massachusetts. Instead, however, of expressing them as something which might be anticipated, they are here quoted as the actual conclusions of a long experience.

Actuated by these considerations, the commissioners would therefore suggest that the time has come for a practical attempt at the ownership of railroads by the State, and their management with a direct view to the interests of the public. They would there recommend that the Legislature, under its reserved power, take measures to immediately assume possession of some line of railroad within the limits of the Commonwealth. The next question is—Where and under what circumstances can the experiment most advantageously be tried?—Which of its roads can the State most advantageously assume? Numerous considerations would tend to influence a recommendation on this point. It is highly desirable that the road upon which this delicate experiment is to be tried should be wholly within the jurisdiction of Massachusetts; it would not be wise to imperil such a movement through the possible jealousy of one State at the ownership of a railroad within its borders by another State. Here, in fact, lies the great difficulty in the way of State ownership—a difficulty which no one yet has endeavored to theoretically meet. Massachusetts would certainly be very unwilling to see New York assume possession of the Boston & Albany under some clause in the West Stockbridge & Albany charter, and proceed to manage that road "by the people of New York for the people of New York;" and so Connecticut and New Hampshire might not impossibly entertain a similar jealousy as regards roads partly within their limits. Whether this should prove to be the case or not, however, it is very desirable that so serious and wholly unnecessary a risk should not endanger a mere preliminary experiment. In that experiment, at least, while there are railroads wholly within the limits of the Commonwealth, there need be no question of jurisdiction involved. The next consideration is one of expense. It is not, in the opinion of the board, advisable for the Commonwealth to involve itself too deeply at once in a novel experiment. There are in the State several roads of limited size and cost which would include every desired condition, and the possession of which could not entail any very serious loss or inconvenience, even in case of failure. In case of success, however, it is very desirable that the experiment should admit of a natural and indefinite expansion in the directions in which it was commenced—an expansion, indeed, in the nature of a natural growth or development.

All of these conditions are perfectly supplied in the case of only one of the railroads of the Commonwealth—that between Boston and Fitchburg. This road lies wholly within our jurisdiction; it could be assumed by the State for a moderate sum; in case of failure it could be disposed of without serious loss or public inconvenience; and, finally, in case the experiment resulted in success this route admits of indefinite expansion. In the last respect there is a peculiar propriety in selecting this road as the one on which to try the proposed experiment. The Hoosac Tunnel, it is now confidently stated, will be completed before the year 1874. It has been constructed solely by the public money, and it would be eminently fitting that, when completed, it should be managed solely in the public interests. By January, 1874, the experiment of State ownership and of public management would be so far advanced that a judgment could be formed as to the expediency of extending it. Were that judgment favorable, the rest of the line to Troy could then be assumed, and any question of State jurisdiction would thus be deferred until the preliminary experiment was an approved success, and then it must necessarily present itself. Were the results still encouraging and were this difficulty overcome, the State road, commencing with the present 51 miles of the Fitchburg corporation, developing without undue haste and with no necessary assumption of risk or disregard of delicate interests, would in time place Massachusetts in direct communication with the Canadas, the West and the Middle States; through the northern railroad system and Lake Champlain it would receive the breadstuffs of the wheat-growing region and the ores of the Adirondack; through the channels of the Delaware & Hudson Canal Company, it would communicate directly, both by water and rail, with the coal fields of Pennsylvania. No other route in Massachusetts so properly and undeniably belongs to the community—for this route the tunnel will create, and the Commonwealth made the tunnel; in assuming it she would assume but her own. The commanding position of the line in the future is now scarcely appreciated; towards the north and northwest it has all the advantages of the Boston & Lowell road; towards the west and southwest all those of the Boston & Albany; situated between the two, it could bring to bear a direct competition on each, and thus at once practically regulate the whole railroad system of the Commonwealth.

The commissioners would, therefore, recommend the Legislature to take immediate steps toward assuming possession of the Fitchburg Railroad. While making this recommendation they do not propose to enter into particulars as to the steps involved in carrying it out, or to report any draught of a bill. These, however, as well as the main subject, have been matters of anxious and careful consideration with them. Should the Legislature or the Committee on Railways be disposed to proceed in the path indicated, the services of the commissioners will be at their command. A very few days, it is believed, will suffice to mature all necessary legislation. Until, however, there is some indication that this is desired, and until the general subject can receive the consideration of the committee, the commissioners have not felt disposed to encumber this report with details. They propose only to offer a general sketch of a policy.

On two points, however, they desire at the start to place their opinions on record, and to remove all possibility of misconstruction.

1. As regards the rights of the present owners of the Fitchburg Railroad Company.

2. As regards the question of State management.

The commissioners cannot entertain a doubt that, in so far as the rights of private property are concerned, they will be guarded with great jealousy in any legislative action which may be had. Not only should the letter of the law be conceded, but in all doubful cases the Commonwealth should decide against itself. It should be remembered that the stock certificates of these railroads are not only the title-deeds of property, but the patents of public benefactors. They represent private means supplied to carry out a great public enterprise surrounded in its early days by doubt and risk. It may now be advisable to resume the ownership of the enterprise, but it is especially fitting that every reasonable claim of the present owners should be met in a spirit both of justice and liberality.

The Fitchburg Railroad Company now owns, in main and branch lines, 93.23 miles of track, with 50 miles of double track and 26 miles of siding, being in all, as near as may be, 169 miles of single track. This property is represented by $3,640,000 in stock, the corporation being free from all indebtedness and having a balance of $501,230 in its treasury. Computed in the usual method, the road would be said to stand at an an average cost of $38,000 per mile, as represented by all outstanding evidences of property.

There are three methods by which the State can take possession of the fanchise and possessions of this company, viz:

1. Under section 84 of chapter 39 of the Revised Statutes which provides that "the Commonwealth may, at any time during the continuance of the charter of any railroad corporation, after the expiration of twenty years from the opening of said railroad for use, purchase of the corporation the said railroad and all the franchise, rights and privileges of the corporation, by paying therefore, such sums as will reimburse them the amount of the capital paid in, with a net profit thereon of ten per cent. per annum, from the time payment thereof by the stockholders to the time of such purchase."

2. Under the declaratory Act of the last Legislature (Acts 1870, chap. 325, § 2), which provides that "the Commonwealth may at any time take and possess the road, franchise and other property of any railroad corporation after giving one year's notice in writing to such railroad corporation, and paying therefore such compensation as may be awarded by three commissioners, who shall be appointed by the Supreme Judicial Court, and shall be duly sworn to appraise the same justly and fairly. Said commissioners shall estimate and determine all damages sustained by any such railroad corporation by such taking of the road, franchise and other property thereof, and any such corporation aggrieved by the determination of said commissioners, may have its damages assessed by a jury of the Superior Court in the County of Suffolk, in the same manner as is provided by law with respect to damages sustained by reason of the laying out of ways in the city of Boston."

3. In the usual business manner pursued by individuals or corporations in similar cases, through negotiation and purchase; as has been done in the case of the telegraph system by the Parliament of Great Britain, and is proposed as regards the railroads of Ireland.

If the Commonwealth took possession under the method first stated, it would be necessary to compute the excess of interest at ten per cent. over the dividends actually paid by the corporation since it was organized. The commissioners have not verified the figures contained in the report of the commission on cheap transportation to the Legislature of 1870 (p. 68), but, assuming them to be correct, the amount of dividends now in arrear appears to be between 92-3 per cent. of the capital, amounting to a total of $3,357,000, aggregating, together with the stock capital, almost exactly $7,000,000; or, otherwise stated, the road, if purchased in this way, would cost the Commonwealth in the immediate neighborhood of $75,000 per mile, or $192 per share. As the stock now commands a market price of $136-7, any arrangement of this nature would certainly constitute no hardship on the shareholders.

In this connection it is of interest to see what, on the same basis of computation, would be the cost to the Commonwealth of its other leading railroads. According to the tables already referred to, the cost of the Boston & Maine would be $146 per share, or in round numbers, $80,000 per mile; that of the Eastern, $177 per share, besides a bonded debt of $3,037,400, amounting to about $104,000 per mile; that of the Boston & Lowell, $180 per share, besides a bonded debt of nearly $255,000, amounting to about $113,000 per mile; that of the Boston & Providence, $185 per share, amounting to about $105,000 per mile; that of the Old Colony, $167 per share, besides a funded debt of $2,986,600, amounting to $79,000 per mile. Owing to the consolidation of the Boston & Worcester and the Western railroads, and the complicated questions involved, it is very difficult to estimate the excess of interest over dividends due on the stock of the Boston & Albany. It is, however, not unsafe to say that at the time of consolidation, a deficiency of $2,415,000 existed as regards the Boston & Worcester, and $1,400,000 as regards the Western, aggregating $3,815,000, without including the stock dividend of 1868. The present capital and indebtedness of the consolidated road is not less than $21,000,000, making an sggregate in the neighborhood of $25,000,000 on 250 miles of road, or $100,000 per mile. Even, therefore, through the extravagant method provided in the original Act, the Fitchburg road would seem to be in its cost per mile the cheapest in the State for the Commonwealth to assume.

The commissioners are unwilling to commit themselves to any estimate as to the value of this road should the Commonwealth desire to possess itself of it in the method prescribed in the Act of 1870. It is wholly impossible to say what rule or measnre of damages the commission or court would lay down in the premises. If the actual present value of the property, or the cost to replace it as it stands, was the measure, it is impossible without long examination to say what that would amount to. It would, undoubtedly, largely exceed the average of $38,000 per mile, at which their road nominally stands on the books of the company. It would, probably, considerably exceed the present market value of the stock, but the commissioners can form no reliable estimate whether it would exceed or fall short of the $75,000 per mile arrived at through the computations heretofore made.

Tbe other, and in the opinion of the commissioners, the most judicious method to pursue, is that through negotiation and purchase, reserving the statute methods as a final resort. This method avoids all litigation and hard feeling, and is the more simple and expeditious, as well as much the most economical. The stock of this corporation has of late received eight per cent. dividends, and now sells in the market for about $136 per share. Under the law of the Commonwealth the dividends are practically limited to ten per cent. per annum. During the last ten years the company has averaged 7.4 per cent. annual dividends, and has never risen above 9 per cent. During the last year it has barely earned its usual dividend, its gross receipts falling off about $85,000, and its net earnings nearly $40,000, their estimated amount ($303,000) being equal to a dividend of 8.32 per cent.* In view of this decrease apparently the directors of the road have fallen into, what the commissioners cannot but consider, the fatally short-sighted policy of raising the rates of their local freight tariff. This mistake is rather likely to increase than decrease the falling off, and the company can hardly look forward with any confidence to being for an indefinite time to come more than an eight per cent. road. Assuming this as a basis of negotiation, it is difficult to see on what ground the corporation could refuse an offer from the State of guaranteed six per cent. bonds at par in exchange for the stock of the road at a premium of $50 per share. Every holder of such bonds would, in place of eight per cent. dividends, subject to all sorts of contingencies, and with ten per cent. in remote possibility, annually receive from interest and after exchange nine per cent. guaranteed, or in cash, $14 per share above the selling market price. Purchased on this estimate, the road would come to the Commonwealth at an average cost per mile of $50,000 and the commissioners think it safe to say that such a purchase would be one fair and advantageous to both parties. The question is, indeed, not without difficulties, but difficulties of the same nature surrounded the purchase by government of telegraphs in England and of railways in Ireland, and were not found insuperable. Until, however, they could know directly and distinctly what are the wishes and policy of the Legislature on this subject, the commissioners have not, of course, felt at liberty to make any overtures to the parties in interest.

Upon the second point, that of State management, the commissioners desire to express their hope that State ownership will not be found to necessarily imply State management. Indeed, in their opinion, the whole result of this important experiment turns on the success with which the question of management can be kept out of politics—can be held distinct from all party machinery. In this respect many excellent provisions are contained in the bills reported to the last Legislature by the commission on cheap transportation. The end in view is to provide a machinery through which the direction of the road shall be confined to trustees, with duties in the nature of those ordinarily pertaining to supervisors of highways. Neither the State nor the trustees undertake personally to manage the road, but they simply produce a paid manager, who, only, is directly responsible, and who takes charge of the road under the advisory supervision of the State trustees. One improvement in the machinery proposed, the commissioners wish decidedly to recommend. Recent scandalous proceedings in other states have illustrated the necessity of introducing some form of minority representation into corporate elections. In the case of the Erie Railway, and in that of the Boston, Hartford & Erie, many of the largest, as well as the most respectable, of the stockholders of each company, are absolutely deprived of all participation in the management of their property, and even of the power to protect it. However the system of minority representation hitherto suggested may apply in practice to complicated popular elections, no question can exist that they are perfectly adapted to corporate elections, and would furnish a great safeguard against evils now notorious. If the trustees for the proposed road are,

* As the returns for 1870 include but ten months, exact amounts cannot be given. In the above statement the returns of ten months are averaged over the entire year.

therefore, to be elected by the Legislature and from the community at large, it would be well to adopt some system which will enable any considerable class in the community to obtain a representation among them in order to introduce into the board that activity of thought and management which results from the mere discussion of theories, which may yet be rejected; and, finally, this would afford every human precaution against those dangers which, in this country, so easily beset all public industrial enterprises.

Before bringing this long report to a close, it only remains for the commissioners, in few words, to restate the policy they wish to see initiated. They propose that the two systems of operating railroads—that through a public, and that through a private management—should be placed side by side, each under the auspices most favorable to development, and subject to no laws but those of Massachusetts. Both systems will distinctly understand that they are on trial; the private corporations will have a reasonable time afforded them in which to justify the existing management; but, if their results through the coming year are less advantageous to the public than those produced through State control, they must be prepared to surrender their trusts into the hands which conferred them. The managers of these corporations cannot complain that the trial is not a fair one, upon the ground that the State road will be operated regardless of profit, while they will be expected to keep up their dividends. The State road must, under public management, pay the interest on its whole purchase cost, being the equivalent of at least nine per cent. dividends on its present outstanding stock. If, in addition to this, it fails to keep in repair its material, and to develop its traffic, then the experiment must end in utter failure. The advantages will, in fact, for some years, be wholly in favor of the private corporations. Their burdens will be no heavier; their machinery and organization will be the more perfect. Uader these circumstances, they should, as finally putting to rest an issue which hitherto they have regarded with apprehension, gladly accept the test, rather than shrink from it. Finally, the corporations and a large portion of the public have strenuously maintained that, in this country at least, the railroad system could most advantageously be managed, both for energy and economy—as regards the railroads, and as regards the community,—through private enterprise. This, as they have already intimated, the commissioners are disposed neither to deny or to concede; it is a subject upon which their minds are wholly open to conviction. They simply desire to try the experiment. Even those who oppose the public control of railroads upon economical or political considerations, can scarcely object to the trial of so limited and carefully restricted an experiment as that now proposed, if only that they may see their anticipations practically realized. Such an unreasoning antipathy to change would exceed even the conservatism of the British Parliament, which is now preparing to devote the whole railroad system of Ireland to a fair attempt at the solution of this difficult problem. The commissioners have only further to say, that they believe the course they have marked out combines as many advantages, with as few dangers, as any which is likely to be suggested; certainly, if it should prove otherwise, the failure will not arise from any lack of anxious consideration on their part, or from any want of a due sense of the heavy responsibility under which they have been called upon to advise.

JAS. C. CONVERSE,
EDWARD APPLETON,
CHAS. F. ADAMS, JR., } Commissioners.

The Mont Cenis Tunnel.

The Mont Cenis Tunnel, as the great shaft through the Alps which is to form part of the railway between Savoy and Piedmont is generally called, has now, as we learn by telegraph, been so far completed as to form a continuous communication from end to end. Strictly speaking the tunnel is not through Mont Cenis at all, but it passes through the chain of the Cottian Alps in a wholly different direction. In the district through which the tunnel passes the chain of the Alps extends nearly due east and west between two nearly parallel valleys. On the south side the Dora Riparia descends through a narrow defile to Susa, and by a broader channel runs thence to Turin. On the north side of the Arc flows in an opposite direction from Lanslebourg to Modane and St. Jean de Marienna before joining the Isere on its way through France, where both are united to the Rhone at a short distance from Valence. The present highroad mounts gradually the valley of the Arc to Lanslebourg; then, turning to the south, it gains the summit of the pass at Mont Cenis by a short and steep ascent of about 2,000 feet. The Mont Cenis route would, therefore, have presented many difficulties, not only in the way of construction, but its gradients would have been of so severe a character as greatly to detract from the usefulness of the line. In the plan which has been adopted the northern entrance to the tunnel will be below Modane, about eighteen miles west of Mont Cenis, and the trains will emerge into daylight near the small Italian village of Bardonneche, at a slightly higher level than the entrance at Modane. From this point twenty-five miles of very difficult railway will be required to provide communication with the Italian railway system at Susa. In addition to the advantage of having the two ends of the tunnel nearly at the same level, this route has the advantage of being a shorter route than any other that had been suggested for traversing the Alps between Savoy and Piedmont. At the time this great work was commenced he would have been considered a madman indeed who would have predicted that when it was completed the Indian mails from England would have been sent to Brindisi because the occupation of a greater part of France by the Germans rendered it impossible to send them *via* Marseilles. If the work were now complete, and France still in the same condition as it was seven years since, the rivalry between the Marseilles and the Brindisi routes would have been a severe and protracted one. The Franco-Prussian war has, however, hastened forward the solution of the question of the relative advantages of the two ports, and it will be the fault of the Italian Government and the directors of the railway companies of the peninsula if the Italian port, the merits of which have been so forcibly pointed out in the several reports of Captain Tyler, of the Board of Trade, does not permanently supersede Marseilles as the point of arrival and departure of the overland India and Australia mails. Brindisi is four days nearer to Alexandria than Marseilles, and it is two days nearer than Trieste. From Susa to Pescari, and thence to Brindisi, a distance of 600 miles, the railway is complete on the Italian side, and in the long run the 600 miles of railway must supersede the 800 miles of sea passage on the Mediterranean.

The great tunnel which is the key to this system of overland communication is 12,220 ft., or rather over 7½ miles, in length. It is, of course, the longest tunnel in the world; about 2½ times longer than the celebrated Box Tunnel, the *chef d'œuvre* of Brunel. At a not distant day we may expect to find that this sub-Alpine shaft has been distanced as completely by other works of the same kind as is that which on the Great Western Railway was considered the wonder of engineering works of its day. The experience which has been gained in what will still be called the Mont Cenis Tunnel, the admirable manner in which the forces of air and water have been combined to aid in pushing forward the work, and the skill with which mechanical appliances have been pressed into the service of the engineers, have removed many of the greatest difficulties which formerly stood in the way of this class of undertakings. To such an extent has science lent her aid that we are able at the close of 1870 to announce as *un fait accompli* a work which it was anticipated would not have been finished before 1875. The completion of the sub-Alpine tunnel establishes the possibility of a similar work between England and France, inasmuch as it has settled the important question of the possibility of constructing long lengths of tunnel without the employment of ventilating shafts.

The manner in which this difficulty has been overcome illustrates one of the most successful applications of a well-known law of physics—viz., the elasticity of the air. For the purpose of boring the face of the rock, forces greater than any which manual labor could employ were requisite. Steam was out of the question, for its discharge, after having done the work, would have filled the shaft in which the work was going on with vapor, and it would have been all but impossible to convey steam in pipes for nearly four miles, which, working from each end of the tunnel, would be the distance it would be required to be conveyed in order to work the drills. It was something more than "a happy thought," it was the deduction of the calm and reflective genius of the engineers—Messrs. Grandis, Grattoni, and Sommeiller—that led them to obtain and apply compressed air as the mechanical agent for the solution of this great mechanical problem. Not only was the air to be caught and imprisoned, and made to do the bidding of the engineer, but means were to be provided, suited for the locality and to the conditions under which the work was to be performed, for thus arresting and binding the aerial forces. To have employed steam power to compress the air would have rendered necessary the consumption of large quantities of fuel, which could with difficulty be obtained in the passes af the Cottian Alps. The able men in charge of the work saw in the stream of water which came leaping down the mountain sides a power which they could press into their service, and they caught and diverted the stream, and directed it on to powerful water wheels, which, working the pumping machines, compressed the atmospheric air into one-sixth of its natural volume. For some ten years or more, in the bleak solitudes of these Alpine passes, the great contest has been going on, and man has been silently but surely conquering the forces of nature, and making them do his bidding. The water has vanquished the air, and the air has forced the iron and the steel wrung from the unwilling ores through the hard schist and the quartz of the Alpine mountain ranges, and directed with rare skill they have burrowed their way through a darkness so black that it might be felt, through the very heart of the Alps.

When the machinery set in motion by the water wheel had compressed it, the air was conducted through iron pipes a foot in diameter into the tunnel, and which were lengthened as the work was pushed forward. The machinery employed in drilling the face of the rock consists of a strong iron framework, with wheels and axles and rack work, to the rear part of which flexible tubes conveying the compressed air are attached. The escape of the air sets in motion a kind of mitrailleuse, which shoots forth from each of its dozen barrels a boring-rod, or "jumper." The instant the blow has been struck against the face of the heading a portion of the air is set free, the "jumper" returns to its place under a slighter pressure of air than that required to drive it forward, and instantly starts to its work again, thus keeping up a continuous succession of blows against the rock. About one hour is sufficient to bore a hole nearly a yard deep—the distance varies, of course, with the hardness of the material to be drilled. When the face of the rock has been pierced by about eighty holes of these dimensions the "mitrailleuse" is detached from the main tube conveying the compressed air and is withdrawn 100 yards or so and is secured behind massive folding-doors. Another set of miners then enter the gallery which has thus been cleared, charge the holes with powder, light the fuses, and retire for safety behind the folding doors which protect the machine. After the explosion the *debris* is removed in small wagons running upon narrow rails on each side of the main track. In about six hours the road is cleared, and the modern battering ram is again advanced forward to repeat its former work of piercing the rock. Before being used all the boring instruments are tested against blocks of the hardest marble that can be found, and many thousands of them unable to stand that test have been cast aside during the progress of that work. For the purpose of keeping the "jumpers" cool while striking the face of the rock, jets of water are discharged by the machine into each of the holes during the process of the formation. The machine employed in penetrating the rock opens a shaft 12 ft. wide and 8ft. in height; the work of enlarging the gallery and securing the whole against future accident by masonry is performed by manual labor. The rock consists for the most part of metamorphic schist of variable composition, for the most part extremely hard, and very difficult to work in parts where it is traversed by veins of quartz, which sorely try the hardened steel points of the "jumpers," and in excavating which the progress was necessarily very slow.

The compressed air emyloyed as the motive power, when set free from the machine, has been found sufficient for the purpose of ventilating the tunnel, and after the explosion of the mines jets of compressed air are employed to drive out the gases produced by the burning of the gunpowder. This useful agent, the air, is therefore employed, not only to pierce the hard rock, but to drive out the noxious gases, and furnish a supply of pure and wholesome air for the tunnel. Gas is employed to light the tunnel in place of the ordinary miners' lamps.

Not the least of the difficulties which opposed themselves to the construction of a tunnel of such great length, was that of insuring the direct course of the work. The tunnel was, as usual, attacked from both ends, from the French and Italian sides, at the same time, and the slightest fractional deviation from the course laid down would have resulted in enormous error by the time each party of workmen had arrived midway in the excavation. There have been instances where two sets of men thus working have passed each other at the spot where they should have met. Any casualty of this kind would have been a very serious affair, and it must have been with no small feelings of satisfaction that a few days since the workmen on the French side heard the sounds of their brother workmen coming forward to meet them; and France and Italy have now been enabled to shake hands in the center of an Alpine range some thousands of feet below the surface. The difficulty of preserving the true line was increased by the fact that no shafts could be sunk down from the surface from which observations could be made. Then, too, the line was necessarily on an incline to the center of the tunnel, for the purpose of facilitating the removal of the rock and the rubbish, as well as for draining the tunnel from any water that might enter by filtration or otherwise. This gradient is about 1 in 50 on the Italian side, but much more favorable on the French side. For the purpose of testing the course of the work, signal stations were erected across the mountain precisely over the intended line of the tunnel, the positions of which were most accurately noted from the observatories erected opposite the mouths of the tunnel. On the days when the tunnel was clear of smoke and vapor—and these were on certain holidays—the accuracy of the lines was verified by means of a brilliant light placed at the further end of each section of the tunnel, and which could be seen from the observatories. Except upon these holidays, no observation of the kind could be made, as, owing to the higher temperature in the interior of the tunnel as compared with the outer air, the atmosphere, charged with aqueous and other vapors, which were driven out by the compressed air when it mixed with the colder air near the mouth of the tunnel, was formed into heavy steam or vapor, through which the signals could not be seen.

The law authorizing the construction of the tunnel was passed in 1857, and the work commenced in August of the following year, was carried on for three years on the Italian side, and for five on the opposite, and resulted in the completion of about one mile in length. This gave at the rate of one mile in four years, and carried on upon this system—assuming it possible to have done so—the work would have taken thirty-two years to complete. By the plan which has been adopted, and which we have just described, the tunnel has been constructed at the rate of one mile a year, under circumstances in which it was possible only to work on two faces at the same time, and at extreme distances from the base of operations. As a result, the work has been finished in five years less time than was anticipated, and the result will, in all probability, show at a cost very considerably within the estimate of £2,000,000, or £50 per foot forward. A very handsome bonus will accrue to the Italian Government and the engineers from the French Government, for having completed the work within the specified time.—*London Railway News.*

—The last number of the *Commercial and Financial Chronicle* contains an advertisement of the issue of bonds by nineteen railroad companies, amounting in the aggregate to about $64,000,000, besides the Northern Pacific bonds and Lake Shore & Michigan Southern bonds, the amounts of which are not given.

—The Finance Committee of the Senate, to which was referred the subject of the assessment of the New York Central scrip dividend of 80 per cent., has reported that the question is one for the courts alone.

—James A. Weston, the Democratic candidate for Governor of New Hampshire, is a civil engineer by profession.

Experiments with Steel-Topped Rails on the Erie Railway.

The following letter narrating the results of the use of rails with puddled steel-tops on the Erie Railway, and giving a comparison of these with iron rails put down at the same time, was received from Abram S. Hewitt by the Massachusetts Railroad Commissioners and published in their report:

NEW YORK, Dec. 15th, 1870.

We have now reached definite conclusions in regard to steel-topped rails. We have made an inspection of every rail laid prior to January 1, 1870, on the Erie Railroad of our make, whether steel-topped or iron. You bear in mind that the steel used for the heads is puddled, and not cast or homogeneous steel. It is necessarily of low temper, in order to secure a weld with the iron.

It is harder and has more tensile strength than iron, but it is softer and has less tensile strength than cast-steel, even of the low grade (so far as carbon is concerned) used for Bessemer and other steel rails.

A priori, it might be expected that the durability of this material would be intermediate between iron and steel—that is, more durable than iron and less so than steel. It is also intermediate in cost, and the problem to be solved is, whether iron rails, or iron rails with puddled-steel tops, or cast-steel rails are more profitable with a given volume of business.

I think that it is now demonstrated that with a small business, where iron will endure from 12 to 15 years, iron is the more economical material; with a larger business, where iron will endure five years, the puddled-steel tops are the cheapest; and with a larger business, where the average life of an iron rail does not exceed three (3) years, steel rails are the cheapest. Our experience is mainly confined to the Erie Railway, which comes within the third category. In arriving at this conclusion we assume that good iron rails cost $75 per ton, puddled-steel headed rails $90 per ton, and cast-steel rails $105 per ton.

Now for the results on the Erie Railroad, premising that we have made no inspection of the cast-steel rails laid down, and can therefore institute no definite comparison with them, but we are told that the failures during the time covered by our report have been comparatively insignificant, and we believe that the report is true.

The total number of rails delivered, prior to the date when the inspection began, was 46,276 rails; of these we found in track 45,716 rails, and 560 rails were not found. Some of these 560 rails may have been overlooked in the track; but in making up the results, we have assumed them to have entirely failed, thus making the worst case for the durability of the rails.

Again, the rails were made by several different methods of piling, some of which have proved to be better than others; and the result would therefore have been more favorable if all the rails had been made by the method which experience has proved to be best.

Of the total number of 46,276 rails, there were puddled-steel tops, 36,238; iron rails, 8,103; doubtful marks, 1,935; by "doubtful marks," is meant that the inspector could not determine to which class the rails belonged.

The average time of wear in track of these rails is 13 months; and this average time is equal for the steel-topped and the iron-topped rails; so that the comparison is perfectly fair as to the time, but as a general rule the steel-topped rails where laid in places where the wear is greatest. To that extent the comparison is more favorable to the iron rails than it should be.

The results of the inspection are as follows:

STEEL-TOPPED RAILS.

Good rails in track	34,867	
Imperfect rails in track	833	
Failures, including missing rails	538	
Percentage of failures	1.5	per cent.
Percentage defective in track	2.3	"
Total percentage failed and defective	3.8	"

IRON RAILS.

Good rails in track	6,934	
Imperfect rails in track	593	
Failures, including missing rails	576	
Percentage of failures	7.1	per cent.
Percentage of defective in track	7.3	"
Total of failed and defective rails	14.4	"

DOUBTFUL RAILS (WHETHER STEEL OR IRON).

Good rails in track	1,738	
Imperfect rails in track	103	
Failures, including missing rails	94	
Percentage of failure of rails	4.9	per cent.
Percentage of defective rails	5.3	"
Total percentage of failed and defective	10.2	"

These results go to show that these doubtful rails were mostly iron rails.

For general conclusions, the result may be stated that on the Erie Railroad where the business is enormous, and from the width of the gauge, the weight of the cars and locomotives is far greater than on narrow gauge roads, and the rate of speed is fully equal to any other American road.

Fourteen and four-tenths per cent. of iron rails made in the best possible manner failed in thirteen months' wear, at which rate all the rails will be worn out in ninety months or seven and a half years, making the average life of the rail three and three-quarters years.

Three and eight-tenths per cent. of puddled-steel topped rails failed, at which rate all the rails will be worn out in three hundred and forty-two months, equal to twenty-eight and a half years, making the life of the rail fourteen and a quarter years, if we assume that the failures will go on at the same rate and that the rate of failure will be uniform for each kind of rail.

I consider, therefore, that the results on the Erie Railroad have fully justified the policy of substituting steel-topped rails for iron rails, at an extra cost of ten dollars per ton (in their case), and if *all-steel* rails could be had at an extra cost of ten dollars per ton over the cost of these steel-topped rails, I believe that a still greater economy would result.

This conclusion still leaves open the question whether a cast-steel top may not be advantageously applied to an iron rail, but I do not consider this point of much practical importance, bucause I believe that all-sleel rails can be made as cheaply as iron rails with cast-steel tops, and all difficulty in reworking old steel rails has disappeared with the full success of the Martin process for melting steel scraps on the open hearth of a reverberatory furnace.

The practical result of the renewal of the eastern portions of the Erie Railway with steel-topped rails has been to reduce the requirements for new rails from two thousand tons per month, when Mr. Gould assumed the management of the road, to about six hundred tons per month at the present time. The requirement may, however, be expected to increase rather than to diminish from this time henceforth; but being reduced to so small a quantity, I have advised Mr. Gould to have the Trenton Works prepared for the manufacture of all-steel rails for future renewals, whereby I anticipate that the life of the track will be doubled.

The policy of getting to all-steel, by means of puddled-steel tops, by which the old rails were made available and the outlay kept within moderate limits, is most suggestive for roads doing a large or an increasing business; and it is probably the only practicable method of arriving at the ultimate desideratum of an *all-steel* track, without taxing the resources of the railway corporations beyond their immediate strength to bear.

Faithfully yours,
ABRAM S. HEWITT.

The State and the Railroads.

Stated in its simplest terms the railroad problem is, how shall the people get the utmost accommodation from these lines at the lowest rate. There can be no question at this day that railroads are semi-public corporations, with duties toward the people using them not less binding than those toward their own stockholders. The right of the State to regulate them, not only by the ordinary police rules applicable to every corporate body, but to fix a maximum rate of tolls and charges, and in a certain event to purchase and manage them for the people, is equally undoubted and needs no argument. It is a remedy of the last resort, however, for evils which cannot be avoided in any other way. The question which thus comes up for consideration, not only now but always, is two-fold: first, do the railroads furnish such accommodation and at such a price as the public have a right to expect? and if not, second, is it expedient to apply the only thorough remedy which the circumstances of the case will allow? Unless a decided negative answer can be given to the first part of the question, no discussion of the second is entitled to much weight. It should be in this, as in all other matters of government, a maxim to add nothing to the public business which can be borne as well by private parties, and to meddle as little with the administration of such private affairs as possible. The railroad commissioners discuss the first branch of the question but briefly, but arrive at a conclusion sufficiently negative to induce them to consider the second branch; and on the matter of state ownership they propose that an experiment shall be made to decide the expediency of a general government purchase of railroads.

We are not led to the same conclusions as the commissioners by the facts which they present in regard to the tariffs charged and business done by the rail roads. It is not our purpose to argue that the railroad companies have fully met all the requirements of the public, or that their own interests would not be equally subserved by a policy which shouid come nearer to meeting them; but it should be shown, in order to secure a condemnation of the private management system, that the roads are doing no more now proportionally for the accommodation of the public than ten years, or five years, or one year ago, and that an exigency has arisen for a change in the system. If there can be shown to be a constantly increasing appreciation of the needs of the public, and a well-devised and partially, at least, successful effort to meet them, the utmost that can be charged is a lack of judgment in the adoption of a more radical policy of improvement. Let us examine one case. One of the tables presented by the commissioners is designed to show that there has been little or no decrease in fares and freights in ten years. The Boston & Maine road is a fair average example. The rate of passenger fare per mile in cents on this road in 186 was 2.13; in 1865 it was 2.56; and this year 2.12. The receipts from passengers in the year ending May 31, 1859, were $465,181; for the year ending December 31, 1869, they were $1,082,643.05, something more than double those ten years before. But while the travel has increased, the margin of profit on each passenger has largely diminished. For instance, while in 1869 the items of repairs to passenger cars and new passenger cars to cover depreciation, amounted to almost $59, 00, in 1859 the whole charge for repairs and renewals of rolling stock, except engines, for all classes of business, amounted to only $26,000. The total charges for engines and cars in 1859 amounted to but $55,000; in 1869 to $210,351. The public has gained very largely in the ease and comfort and elegance of the cars, and the power and speed of the engines used. It has gained in the frequency of trains, as will be found on an examination of the time-tables for the two years 1860 and 1870. In the former year there were two daily trains to Portland, and there are now four; five trains to Haverhill, and nine now. On the shorter routes the number has been proportionally increased. A striking example of this kind of improvement is found in the time-table of trains to Lynn on the Eastern Railroad. By the winter arrangement of 1860–1 there were fourteen trains each way daily; there are now twenty-four. An additional gain has been made in speed and closeness of adherence to the time-tables. It appears that the net earnings for 1859 were $370,000, and for 1869 they had only increased to $490,000.

We are aware of the argument that a lower rate of fares would bring in a larger amount of money, and that the same rule is applicable to freights. We concede also that the companies owe it to the public never to "let well enough alone." We are now simply contending that cheap fares are not the only desirable boon to railroad travelers, and that this road, which may be taken as a fair average of all in the State, gives the public a larger equivalent now than ten years ago in the shape of accommodations improved in the frequency, speed and comfort of trains, for an amount mathematically the same but of smaller purchasing capacity when devoted to rent, provisions or clothing. We fancy, too, that some of the instances of hardship occasioned by overcharges for passenger fares are rather seeming than real. If the fare between Chapel Station and Longwood, on the Boston & Albany road, reaches the rate of sixteen and two-thirds cents a mile, our sympathy with the overtaxed passengers is somewhat subdued when we learn that the distance is less than a third of a mile, which a good pair of legs will walk in five or six minutes. Unless the number of passengers were a hundred times larger on these short routes than could possibly be expected, it could not pay a railroad company to haul up a long train to take them in; and the Albany Railroad may be pardoned for not encouraging a great amount of such travel.

The freight grievance is a separate affair altogether; but this we need not discuss, inasmuch as the commissioners confess themselves baffled by facts which could not be changed by State ownership. It is not the local freights alone which bear hardly on the manufacturing industry of Massachusetts, bu' the through freights. As the commissioners say, we get our food, wool, cotton, leather, ores and coal from points outside of Massachusetts; they are brought over our road, or a part of them, under the combination system, and Massachusetts railroad companies, and the State itself, are powerless to change the system. The law which the commissioners propose regarding *pro rated* goods passing over a part of any line will be as effectual as any legislation can be in this direction, and will be applied as well by private as by public management. Manufacturers who have large quantities of goods to be sent or received, make special arrangements and a special tariff with the companies. The business of transporting small quantities for short distances cannot be well made profitable at very low rates, with the largest possible increase of the business. There is no doubt that if it could be done it would be a great convenience, and would assist materially in building up our centers of business in the interior; but it would be, and would remain an unprofitable traffic for the companies, entailing a loss which they must make up elsewhere, but always out of the people.

The definite proposal of the commissioners, that the State shall purchase the Fitchburg Railroad, in order to try the proposed experiment, is open to some objections which it is worth while to consider while the subject is open, and we shall return to it another day. The obligations of the railroads, themselves, to the public, is another question of sufficient magnitude to be considered in this connection hereafter.—*Boston Advertiser.*

The Gauge Question.

In the course of an elaborate article on the railroad system, the *American Railway Times* says:

"The question as to the proper gauge for railways, which was formerly a favorite subject for dispute among engineers, has finally settled itself in favor of the narrow system, *i. e.*, 4 ft. 8½ in.; not that this particular width is absolutely the best, but that it is the one most commonly adopted, and that the advantages of uniformity so far outbalance all other considerations. Probably a gauge of 5 feet would have been found as nearly perfect for the railway system as a whole, in a mechanical point of view, as any other; and it is much to be regretted that it was not fixed as a national standard at the commencement. The 7 feet gauge in England has proved itself a failure, and is being rapidly reduced to 4 ft. 8½ inches. So, too, in America, the 6 feet of the Erie and of the Ohio & Mississippi has shown the falacy of the reasoning which lead to its adoption, and will doubtless eventually be reduced to the narrow gauge. With regard to the gauges of 5½ ft., 5 ft., 4 ft. 10 inches, in the United States, every year is showing in the plainest manner the point to which they are coming—either a reduction to 4 ft. 8½ inches, or else complete isolation from the general system. One of our most prominent railway managers, J. W. Brooks, Esq., observes upon this point: 'The advocates of the broad-gauge theory of late years have been pretty much confined to its unfortunate victims. The extra weight of its rolling stock, in proportion to the load carried, raises the proportion of non-paying tonnage, and the friction due to the curves is largely in excess of that upon the narrow gauge. In some foreign countries, where such property is protected from competition, the broad gauge roads are prosperous; but where they come in open competition with the narrow gauge, bankruptcy is the rule to which there is hardly an exception. Of the 4,000 miles of broad gauge in this country I know of but one line that is not hopelessly bankrupt, and that makes 2 or 3 per cent. by carrying its through freight on a narrow-gauge, for which it has laid down a third rail. Without the third rail it would be as bankrupt as the rest of them.'"

—There is a rumor that the Pennsylvania Railroad Company has taken advantage of the recent collapse in Union Pacific securities to gain control of that road.

General Railroad News.

OLD AND NEW ROADS.

Woodstock & Riviere du Loup.

The County Council of Carleton County, New Brunswick, have unanimously voted $100,000 towards the construction of a railway from Woodstock to Riviere du Loup, the eastern terminus of the Grand Trunk Railway.

Worcester & Nashua.

The yearly accounts of this Massachusetts company will henceforth close with September. The earnings for the ten months ending September 30, 1870, were $452,546, and the expenses of all sorts $295,685, leaving $156,860 as net earnings, more than sufficient to pay two 5 per cent. dividends on the capital stock, which is $1,400,555. No funded debt, $508 of current bills due, and $3,293 for unclaimed dividends. Of reserved income there is $170,078, besides $387,500 of income which has been expended in construction of road, and the company has also $155,806 assets in fuel and other materials, cash, &c. Officers: President—F. H. Kinnicutt, of Worcester. Directors—Stephen Salisbury, of Worcester; Alexander DeWitt, of Oxford; Jacob Fisher, of Lancaster; Thomas Chase, of Nashua; Asa F. Lawrence, of Groton; Francis H. Dewey, of Warcester; F. H. Kinnicutt, of Worcester; A. H. Bullock, of Worcester; C. B. Hill, of Nashua. Treasurer and Clerk—T. W. Hammond; Superintendent—Charles S. Turner.

Northern Pacific.

Mr. John Ross, who has charge of the tracklaying, expected to have the iron down as far as Mud River, 28 miles east of the Mississippi River crossing at Brainerd, last Saturday, and to Brainerd by the 1st of March, although the ground is frozen 2½ feet deep, and grading is very difficult—good grading, one might expect, quite impossible. The bridge at Brainerd is to be completed by the time the track reaches that place, and much grading will then be ready for tracklaying west of the Mississippi. Sixteen hundred men are now employed on the line, but some of these are discharged almost daily as contracts are completed.

Mr. Ross says that by far the worst part of the road is built; the roughest territory, the heaviest swamps, and the most difficult piling and bridging.

There are now 9 locomotives, 130 flat and 26 box cars on the road, and four more locomotives and 70 more box cars are on the way. There is an engine house at the Junction, (Thomson), over 30 miles west, and a third is to be built 30 miles further west at Mud River.

New York Central & Hudson River.

The following summary of the report of the above company, made to the State Engineer of New York, has been telegraphed from Albany:

"The receipts for the year ending September 30, 1870, were $22,363,319.67, against $22,143,056.21 in 1869, an increase of $220,263.46. The receipts include the sum of $1,135,511.14 from mails, interest, and sources not specified. The expenses, including $168,975.89 for United States tax on earnings, $111,182.38 to the sinking fund, $60,000 for rents, and $1,093,840.80 for interest on funded debt amount to $15,502,078.38 leaving $3,861,241.29 available for dividends and United States tax on the scrip dividend. The capital stock and cirtificates amount to $89,428,330, 8 per cent. on which would be $6,954,244, or about $100,000 more than the amount stated above as available for dividends. No construction account is rendered, as required by law. Last year the construction account was increased $833,542.20 for the Hudson River, and $994,000 for the Central, a total of $1,827,542.20. The expenses as stated above do not include those made for construction, if any such have been made. The operating expenses of the two roads were $5,185,948.57 in 1869, and $5,175,387.95 in 1870, a decrease of $10,560. The expenses for maintenance of road were $5,249,428.80 in 1869, and only $4,564,434 in 1870, while repairs of machinery cost $2,512,455 in 1869, and $3,181,515 in 1870. The funded debt is reduced from $15,708,812.37 in 1869, to $13,682,974 in 1870, while the capital on which dividends are made has increased from $67,851,000 in 1869, to $89,428,330 in 1870.

Memphis & Little Rock.

Mr. J. L. Meigs, Chief Engineer of the company, reports as follows on the progress of construction: "Miles of track laid, 115 77-100; miles of track to be laid, 15 35-100; of the roadbed upon which the track is yet to be laid, 3 14-100 miles are ready for the rails; 1 41-100 miles are very nearly completed, and 3 76-100 miles are half done; the remainder, 6 84-100 have strong forces actively at work on them. White River Bridge masonry will be ready for the drawbridge by January 1st, and the river piers are believed to be so far advanced, as not to be in danger of an overflow this winter. The iron drawbridge is complete, together with the iron work of the fixed spans. The wooden work and brace pieces are sawed and ready for transportation. More than one hundred men are at work on the road and the arrangement for the completion of the Cache River valley earth work and pile work are such that there is no ground to apprehend delay from high water. We may now confidently expect the completion of the road early in 1871."

Portsmouth, Saco & Portland.

This road was, in 1847, leased to the Eastern and Boston & Maine roads for 6 per cent. per annum in gold on the capital stock. The lease expired last week, and the two companies, lessees, want a new lease but the Portsmouth, Saco & Portland Company demand at least 10 per cent. on their capital of one and a half millions.

Portland & Chicago Air Line.

Senator Hamlin, of Maine, has introduced into Congress a bill "to secure the cheap transportation of "breadstuffs and provisions from the West to the sea-"board, at uniform rates throughout the year." The bill was accompanied by a memorial from the Chicago, Portland & European Air Line Railroad in support of the same, proposing to constitute the line of said company a post road and national highway, from Portland harbor, *via* Rutland, to Oswego and Chicago, the government to loan its bonds, to a limited amount, as soon as forty miles are completed with steel rails, iron bridges, and adequate equipments, and so on, at the same rate, as each additional forty miles are completed, till the line is finished to Oswego, and thence at the sams rate to Chicago, if the President of the United States shall so determine. Congress, by law, to regulate the price of transportation, which is to be uniform throughout the year. The road to have capacity for delivering at tide-water, all freight offered at Chicago, or other places on the route, within seven days of its receipt. Ample dock accommodations are to be constructed at Portland for ships of the largest draught.

Such is the report the telegraph gives us. It is said that wheat will be carried from Chicago to Portland for 10 cents a bushel by this line; but this is probably on the supposition that all grain will go by this line and that New York and Boston will cease to be.

Central of Iowa.

But three miles of track remained to be laid last week to complete the road from Mason City to Albia, making a continuous line of 177 miles, the most of which has been built during the past season. From Mason City, on the Milwaukee & St. Paul's Iowa line, to Grinnell, on the Chicago, Rock Island & Pacific road, 115 miles of the road have been in operation for some weeks; the cars have also been for some time running from Albia, on the Burlington & Missouri River road, north about 37 miles to New Sharon, and now that the gap between this point and Grinnell is probably by this time closed, the line will afford a new route from Minnesota to Missouri, and, crossing all the east and west roads through Iowa, will considerably improve the traveling facilities of the State.

Butler Branch of the Western Pennsylvania.

A young correspondent at Zelienople, Pa., writes to us as follows:

"The Butler Branch of the Western Pennsylvania Railroad was opened from Freeport, on the Western Pennsylvania Railroad, 28 miles northeast of Pittsburgh, to Butler, a distance of 21 miles, by an excursion from Butler to Pittsburgh on Wednesday, the 18th of January. This road is a continuation of the Northwestern Railroad which was organized in 1854 to extend from Blairsville 54 miles east of Pittsburgh, on the Pennsylvania Railroad, to Newcastle, Pa. After considerable grading had been done, this company was compelled to suspend operations, through financial difficulties. Its charter was surrendered to the Western Pennsylvania Company, which, with the assistance of the Pennsylvania Railroad, finished the line from Blairsville to Freeport, and thence along the north bank of the Alleghany River to Alleghany City, a distance of 67 miles, in the years 1865-6. The construction of the Butler Branch was begun in the spring of 1870, and finished in January 1871, at a cost of $650,000, or a little over $30,000 a mile, with grades 79 feet to the mile. The stations are Butler, the county seat of Butler County a flourishing town of 2,000 inhabitants; Herman, Delano, Saxon, Sarversville and Freeport, the point of junction with the West Pennsylvania road. This railroad runs through a wild, rough and picturesque section of country, and therefore a great amount of filling and grading was necessary. Whether it will be extended to Newcastle, depends solely on the decision of the Pennsylvania Railroad. This is the first railroad to penetrate Butler County, which with a population of nearly 40,000, a fertile soil, and inexhaustible deposits of coal and limestone, through the want of public spirit and the unenterprising character of its citizens, has thus far been without a single mile of railroad. During the summer of 1870 a survey was run for the northwestern extension of the Pittsburgh & Connellsville Railroad, known as the Baltimore, Pittsburgh & Chicago Railroad, which would run for fifteen miles through the southwestern part of the county, but when it will be built, or if it will ever be, it would not be safe now to predict."

Atchison & Nebraska.

This road is completed to the line between Kansas and Nebraska, 38 miles north of Atchison. The stations and distances from Atchison are: Doniphan, 6½ miles; Brenner, 12½; Troy, 16½; Fanning, 22½; Highland, 25; Iowa Point, 31½; White Cloud, 35½; State Line, 38 miles. It is expected that the line will connect at Rulo with the railroad extending a few miles westward from that place which is to be extended up the Great Nemaha River to Lincoln.

Missouri, Kansas & Texas.

This railroad, which made such wonderful progress last year and has now two lines in operation—one from Junction City, Kansas, southeast to the Indian Territory, and the other from Sedalia, Mo., southwest to Fort Scott—will soon complete the connection of these lines by laying the track on the line from Fort Scott southwest to the Neosho River at Parsons, about 50 miles. It has also so far completed the grading of its extension across the Indian Territory that it expects to have trains running to Fort Gibson, about 90 miles south of Chetopa, in March next. It will then be a hundred miles nearer the Texas cattle region than any other road and will have a good outlet for them through the Sedalia line. But the the extension to Texas will continue, and the managers of the company will not be satisfied until they have constructed their line across Texas and have an independent line to the Gulf. The Fort Scott *Monitor* says:

"This road is not to stop at Fort Gibson, or at Preston, Texas. It is going on to Galveston and the Gulf. It is not to connect with any other road now coming north through Texas, but will be an independent line all the way through. The surveys through Texas are now in progress and will soon be completed. The road can follow the valley of Trinity River through almost the entire breadth of the State at a reasonable expense."

South Pennsylvania.

About twelve miles of grading, between Marion and Mercersburg, Pa., is completed, and it is probable that the track will be laid by about the 1st of February.

Burlington & Southwestern.

The track-layers are now at work, and are nearly through, between Ft. Madison and Farmington. Between Farmington and Bloomfield the line is not definitely located, and may be considerably deflected by local aid. Beyond Bloomfield, fifteen miles, to Moulton, arrangements have been made with the North Missouri Company for the use of their track. Of the proposed Lexington Branch the Burlington *Hawkeye* says: "The company are now negotiating with a railroad company in Missouri, known as the "North Missouri Central," to build a road from some point on the Burlington & Southwestern road southward and southwestward through the counties of Sullivan, Linn, Putnam, Livingstone and Carrollton to Lexington, on the Missouri River."

Eastern Nevada.

This company purposes to construct a narrow-gauge (2 ft. 6 in. or thereabouts) railroad from the White Pine mining district to Elko, on the Central Pacific, a distance of 120 miles, in a difficult country, where teaming is very difficult. The business is likely to be light.

Ottawa, Oswego & Fox River Valley.

The first regular train over this road ran through from Streator to Aurora on the 20th inst. The road is now in full operation, competing with the Chicago & Alton at Streator, and the Rock Island at Ottawa.

St. Louis & St. Joseph.

The creditors of the company met last week at St. Joseph, to select an assignee for the property, and, failing to agree, the register in bankruptcy appointed Col. J. G. Kappner, of St. Joseph, to the position. He will take charge of the road and manage it until some further order is made. The assets are estimated at $1,603,247; and the liabilities, in addition to individual claims amounting to about $150,000, consist of two mortgages—one for $1,000,000, executed in 1869, and one for $1,000,000, executed to John Lionberger, Jas. H. Britton, *et al.*, trustees, in August, 1870. The latter was given to secure a note, which, it is alleged, was sold for 33⅓ cents on the dollar; and it is upon this sale that the proceedings in bankruptcy were instituted.

West Feliciana.

At a meeting of the stockholders of this company, called for November 25, and adjourned to the 2d inst., the amendments to the charter granting the privilege of extending the road from Woodville, Miss., to a junction with the New Orleans, Jackson & Great Northern Railroad, were accepted, and books for subscription opened. The directors and officers elected for the coming year are given in another column.

Omaha & Northwestern.

This road was completed on the 10th inst. to Calhoun, about 18 miles above Omaha. If the severe weather has not prevented, it has since been completed to DeSoto, on the Missouri River four miles further north. Thence to Blair, four miles, is a branch of the Sioux City & Pacific road which the Omaha & Northwestern hopes to buy. It is hoped that good progress will be made beyond Blair before the end of the year.

Kansas City, St. Joseph & Council Bluffs.

The branch of this road from St. Joseph north has been completed to the Iowa line, near which is a station which has been named Hopkins, in honor of the General Superintendent Maj. A. L. Hopkins. Another station north of Maryville is called Pickering, in Honor of the Vice-President, Pickering Clark.

Mississippi Central.

According to the annual report for the year ending August 31, 1870, since the road was turned over to the lessees (the Southern Railroad Association), the total expenditures have been $623,553.64 for permanent improvement and equipment. During the same period the lessees expended the sum of $1,225,569.63 for ordinary repair, and the various items embraced in the operating expenses of the road. Total, $1,849,123.27, thus having expended in the ratio of about $890 per day in the improvement of the property and the operation of the road. The lessees are about to make surveys for an extension from the northern terminus at Jackson, Tenn., to Milan, or some other point on the Memphis & Ohio Railroad in the direction of Paducah, which is to be constructed by the lessees at the expense of the company. This will render the road to a degree independent of the Mobile & Ohio Railroad, which now affords its only outlet to the North. From Jackson to Milan is about 25 miles. The following are the officers of the company for the present year: A. M. West, President; R. P. Neely, Secretary and Treasurer; E. C. Walthall, General Attorney. Board of Directors —General A. M. West, Oxford, Mississippi; Colonel J. B. Fant, Holly Springs, Mississippi; Dr. J. T. Malone, Holly Springs, Mississippi; A. H. Pegues, Oxford, Mississippi; Montford Jones; Dr. C. M. Vaiden, Vaiden, Mississippi; Hon. John A. Binford, Duck Hill, Mississippi; W. A. Drennan; L. Q. C. Lamar, Oxford, Mississippi; General R. P. Neeley, John J. Polk, Esq., Bolivar, Tennessee; M. D. L. Stephens, Water Valley, Mississippi; R. B. Hurt, Jackson, Tennessee; Paul T. Jones, Bolivar, Tennessee; C. H. Anderson, Bolivar, Tennessee; Samuel McClanahan, Jackson, Tennessee.

Muscatine, Tipton & Anamosa.

A great quantity of ties belonging to this company were sold by the Sheriff, at Tipton, Iowa, the other day. The Northwestern bought the lot, at eighteen cents apiece.

Dubuque & Minnesota.

The first installment of the iron for this road is expected this week, and the first ten miles of track are to be laid as soon as the weather will permit. Twenty-two construction cars have been ordered. A contract between the company and the city of Lansing, near the northeast corner of Iowa, has been entered into, by which the road is to be completed to Lansing by the 1st of January, 1872, in consideration of the guarantee of $35,000 by responsible citizens of the place.

Denver & Santa Fe.

An effort will be made to construct a light railroad with three foot gauge between Denver and Santa Fe during the present year. Such a road would be about 350 miles long. There is no probability that it would be overworked for some time to come.

Memphis & St. Louis.

According to the Memphis *Avalanche* three contracting firms have taken the contract for building the Levee road from Hopefield, opposite Memphis, about 150 miles, to Morley, on the Iron Mountain road. Arrangements are making to put a thousand men upon the work in the spring and complete the road within eighteen months.

Burlington, Cedar Rapids & Minnesota.

The road is now completed from Burlington to Cedar Falls, with the exception of about three miles of iron. This gap would have been closed some time since but for the non-arrival of the iron. Everything is in readiness to commence through business as soon as the gap is closed.

Concord Railroad.

There has been a contest for the control of this New Hampshire railroad, which came to an end at the Court in Haverbilt, on the 10th inst. The new board of directors gave Gov. Stearn a bond in the sum of $100,000, to protect him from claims having their rise under his management. They also provide for the payment of $75,000 to aid in building the Claremont Railroad. It is understood, also, that a satisfactory contract has been agreed upon for the carrying of the business of the upper roads. On these and other conditions the Concord road and its branches will be surrendered to the new managers, the Court retaining control enough to decide any business question which may arise in the adjustment of accounts. The new arrangement commenced immediately. The directors are Isaac Spalding, Frederick Smyth, John H. Pearson, James W. Johnson, Edson Hill, Wm. R. Spalding and William A. Tower. The last-named gentleman is President.

Grand Trunk of Canada.

Mr. C. J. Brydges, the Managing Director, advertises that he will now receive tenders for all the wrought scrap iron which the company will have to dispose of during the present year, and for about 6,000 or 7,000 tons of old rails. The duty on scrap iron being comparatively low, there is a good market for all this old iron in the United States.

Plymouth, Kankakee & Pacific.

Mr. T. J. Nicholl, the engineer of this railroad, informs us that the company has more than 70 miles of grading completed, as well as the piers for the bridge over the Kankakee and Vermillion rivers and most of the small streams on the line. Work is progressing finely, notwithstanding the snow, and the company intends to commence tracklaying early in the spring.

Mendota & Prophetstown Branch.

A correspondent writes from Bureau County that, on this new branch of the Chicago, Burlington & Quincy road, the track is laid west to Walnut Station, 26 miles from Mendota. The work on the remaining 19 miles has been considerably delayed by the snow.

MECHANICS AND ENGINEERING.

Improved Lubricator.

A correspondent in Cleveland writes us that he expects soon to offer to railroad companies "a device "that will be very acceptable, yet not entirely new, but "almost invaluable in its economy, comfortable charac-"ter, and adaptation to uneven and curved railroads." He says that he has certificates from prominent railroad men stating as the result of experiments that *one-half* of the expense of lubrication has been saved by it, and hot boxes entirely avoided, and that the saving of time, labor, brasses and motive power has been scarcely less than the saving in oil.

Having thus excited our curiosity, our correspondent makes no attempt to satisfy it, but leaves us and our readers to guess by what means these desirable effects are attained.

Injectors on Locomotives.

Noticing a statement in an editorial in the RAILROAD GAZETTE some weeks ago, that we knew of no locomotives in this country running with injectors alone, *Engineering* says:

"If the American locomotive superintendents have yet not tried working these engines with injectors alone, it is time that they commenced. There are hundreds of locomotives without feed pumps running in this country and on the continent, and hundreds of them with one injector, and the cases of failure with engines so fitted are but exceedingly few, compared with those which take place where pumps are used."

Steel Tires Under Brakes.

Mr. T. A. Rochussen, of London, writes as follows to the London *Engineer* relative to recent accidents on English railroads caused by the breaking of a tire of a wheel:

"Although, during the last twenty years, steel was discriminately used wherever practicable in the permanent way and rolling stock of Prussian railways, and its value recognized long before it found root in English practice, it has always been understood that cast-steel tires should not be applied to wheels running under brakes, and for this reason: The cast-steel tires, when checked by the brake and skidding upon the railway, get very hot by friction; in pulling up in a pool of water, a heap of snow, or even in a keen draught of wind, a cast-steel tire may, under such circumstances, get a hard chill or brittle temper, and, being so injured and deprived of elasticity, it may break at any time, either while running free or under a brake, and that without giving previous sign of existing danger.

"I may add, speaking from my own knowledge of most of the large steel works in Prussia, that, in contracts for material, manufacturers distinctly stipulate that no guarantee is undertaken for cast-steel tires or disc wheels if at any time used under brakes. The only material admissible in such a position is good fine-grain iron approaching in crystallization to very mild puddle steel, which does not temper by sudden cooling; or, if a bias in favor of steel must be over-indulged, the cast steel should be made especially for the purpose, so as not to contain more carbon than wrought iron, with which it would become identical. Such a tire could be safely bolted to the wheel, and this process would, in the Hatfield accident, have been less dangerous than the Beattie fastening, which, although designed to hold the tire on to the wheel even when the tire should burst, in this instance failed to answer its purpose.

"The Prussian Board of Trade prohibit the use of cast steel tires under the brakes of the mail carriages, which, on an average, weigh 17½ tons, and form part of nearly every passenger train throughout the country."

The Electro-Magnetic Brake in New England.

The Massachusetts Railroad Commissioners in their last annual report, while discussing the Providence & Worcester Railroad say:

"Upon some cars of this road Olmstead's electric brake has been applied, which may be put in action on any car by itself, or on all the cars on the train at once, from the engine. The power is furnished by a battery in each car; the electric action keys up a loose wheel on the axle, and this winds up a chain attached to the brake. The advantage of this brake over Creamer's, or any other acting by a spring, is that it is always ready for action and does not need to be wound up every time it has been used. In the experiments witnessed by the commissioners, it did not appear to have any superiority in quickness of action over the common hand brake. The Superintendent of the road, however, stated that this brake had been in use on five cars for two months and had given good satisfaction; that it would stop a train in thirty-three seconds in running not much more than the length of the train."

Railroad Manufactures.

Various improvements have lately been added to the Detroit Bridge and Iron Works. In the blacksmith shop two new upright steam hammers have been put in, to replace smaller ones, at a cost of $3,000 each. At one end of the shop is a handle hammer of enormous power, and used in connection with the two uprights, being also managed by steam power. All the engines used at the works, as well as most of the machinery, are now manufactured by the company themselves. The company are now devoting themselves chiefly to the building of iron bridges, iron roofs, and steam engines.

The Mansfield Elastic Frog Company have declared a dividend of 4 per cent.

Buildings for a new iron rolling mill, to cost not far from $30,000 will be commenced immediately on Grapevine Point, New Haven.

ELECTIONS AND APPOINTMENTS.

—The following persons were chosen directors of the Detroit, Hillsdale & Indiana Railroad Company, at Hillsdale on the 10th inst.: C. H. Buhl, John Owen and J. F. Joy, Detroit; Henry Waldron, J. P. Cook and Wm. Waldron, Hillsdale; D. L. Quirk, Ypsilanti; Wm. H. Davenport, Saline; A. P. Cook, Brooklyn, and J. D. Carey, Manchester.

—The annual stockholders' meeting of the West Feliciana Railroad Company was held at Woodville, Miss., on the 2d inst., and the following directors were elected: J. Burruss McGehee, Scott McGehee, Duncan Stewart, L. K. Barber, Daniel Cohen, Chas. G. McGehee, Geo. T. McGehee, H. S. Van Eaton, E. H. Wailes. Mr. J. B. McGehee was chosen President, and George P. Warner, General Superintendent.

—The stockholders of the Lafayette, Bloomington & Mississippi Railway Company, met in Bloomington on the 18th inst. and elected for directors: A. Gridley, W. H. Pells, O. T. Reeves, C. W. Holder, J. E. Davis, M. L. Sullivant, J. H. Cheney, J. G. Rowland, A. B. Ives, W. H. Riggs, J. C. Bagby, Abner Taylor. The officers are: A. Gridley, President; W. H. Pells, Vice President; C. W. Holder, Treasurer; O. T. Reeves, Secretary. The grading, bridging and culverting is all completed between the State line and the Illinois Central Railroad.

—Mr. O. F. Moore, of Cincinnati, has been appointed General Superintendent, and W. H. L. Noble, General Agent, of the Indianapolis, Cincinnati & Lafayette Railroad Company.

—The old Board of Directors and officers of the Peninsular Railway were re-elected, at Battle Creek, Michigan, on the 18th inst. The officers are: President and General Superintendent, L. D. Dibble; Assistant Superintendent, W. H. Hollister; Chief Engineer, C. F. Mil-

ler; Treasurer, C. W. Wakelee; Assistant Treasurer, Wm. Miller; Secretary and Attorney, M. S. Brackett; Superintendent of Motive Power, Thomas G. Templeton.

—The twenty-sixth annual meeting of the Connecticut River Railroad Company, was held in Springfield, Mass., on the 18th inst., and resulted in the following re-election of officers: President, D. L. Harris, of Springfield; Clerk, Seth Hunt, of Northampton; Auditor, Eliphalet Williams, of Northampton; Directors, Ignatius Sargeant, I. M. Spellman and E. A. Dana, of Boston; D. L. Harris and Chester W. Chapin, of Springfield; Oscar Edwards, of Northampton; W. B. Washburn, of Greenfield, Roland Mather, of Hartford, and S. M. Waite, of Brattleboro, Vt.

—At the annual meeting of the Hartford & New Haven Railroad Company, held in Hartford on the 18th inst., the old officers were re-elected, as follows: President, W. P. Burrall; Secretary, S. P. Connor; Treasurer, C. M. Pond; Directors, W. P. Burrall, Chester W. Chapin, Cornelius Vanderbilt, G. C. Reed, Eli Butler, Julius Catlin, C. M. Pond, H. C. Robinson and E. G. Howe; Superintendent, E. M. Reed.

—Mr. D. L. Quirk has been appointed Superintendent of the Detroit, Hillsdale & Indiana Railroad Company.

—At a recent meeting of the directors of the St. Paul, Rochester & Iowa Railway Company, the officers elected were: W. D. Hurlburt, President; George W. Van Deusen, Vice-President; D. Kenny, Jr., Secretary; T. H. Titus, Treasurer, and C. H. Chadbourne, Geo. W. Van Deusen, and J. V. Daniels, Executive Committee.

LOCOMOTIVE STATISTICS.

Allegheny Valley.

Mr. G. W. Glass, Master Machinist of the company, reports for the month of November, 1870:

The number of miles run by trains was as follows:

Passenger trains	29,867
Freight "	52,567
Ballasting, &c	5,833
Total	88,266

The cost per mile run was:

For repairs	8.01 cts.
" fuel	4.80 "
" stores	.83 "
" engineers, firemen and wipers	7.74 "
Total cost per mile run	21.38 cts.

Average number of miles run to

Pint of oil	34.83
Ton of coal	36.77

Thirty-four locomotives made mileage during the month, one new engine is building, and one has been in in shop for repairs during the month.

TRAFFIC AND EARNINGS.

—The receipts of the Great Western Railway for the week ending December 30th, 1870, were:

Passengers	$25,666 31
Freight and Live Stock	36,708 10
Mails and sundries	2,384 48
Total receipts for week	$64,758 89
Corresponding week, 1869	74,369 01
Decrease	$ 9,610 12

—The number of through passengers going west over the Central Pacific Road in 1870, was 32,241; going east 23,795, leaving a gain to the Pacific coast of 8,446.

—The Bay City (Mich.) *Journal* notices as follows a new development in the lumbering business in that section. Carrying logs by rail has long been common in the South, however, where the lack of snow makes transportation to rivers more costly than in the North: "Thursday, twenty cars loaded with sawlogs arrived here from the western terminus of the Flint & Pere Marquette Railway, being the first installment of a contract the company have to deliver 30,000,000 feet of logs at this point as fast as they can be transported. This is something new in the history of lumbering operations, and it promises the best results. The cost of transporting these logs is only about $3 per thousand feet, and when the loss of the expense of rafting, which is always heavy, is taken into consideration, it will be readily perceived that the new system is the cheapest, and no loss whatever involved. The company have perfected arrangements for unloading the logs into the river with the utmost dispatch. Two trains, on this contract, will run over the road per day, the entire lot making 12,000 car-loads."

—The Springfield *Republican*, always guarded in its statements, says of Mr. George Bliss, the New York merchant and banker, who succeeds Oliver Ames as President of the Union Pacific Railroad Company: "He is a gentleman of high business character and much wealth, and will be able to do much in working the corporation out of its present financial embarrassments."

Contributions.

RAILROAD LEGISLATION.

It is, perhaps, a stale quotation, but worth repeating, that the man who discovered how to make two blades of grass grow where only one grew before, did more for his fellow men than the whole race of lawyers and politicians put together.

May it not, also, now be said, that the introduction of any method of diminishing the cost of transportation, thus stimulating production, and adding to the comforts and conveniences of human life, is one of the greatest objects of political economy.

Who can fairly estimate the immense advantages conferred on society by mechanical improvements and the advancement of science? The steam engines, the railroads and telegraphs are, justly, the glory of the age; but to trammel them with legislative enactments is, plainly, suicidal in its tendency.

Railroads have built up the State of Illinois and have developed its resources with astonishing rapidity. What if railroad corporations have grown rich in the exercise of rights and privileges granted by our representatives, and, in the course of events, we have discovered that they are great monopolies? In what manner can we justly counteract these results, or where is the necessity?

The present Legislature of Illinois, with commendable zeal, is trying to protect the interests of its constituents against the exorbitant charges of these companies, and it is proposed to restrict them by fixed rates. Two years ago an attempt was made for the same object, but our General Assembly being conscious of its inability to devise an equitable mode of preventing the exercise of power they had previously granted, took a sensible view of the whole subject and concluded that prices could only be brought down to the true standard by effective competition. Unfortunately, they were wholly forgetful of the fact that, under existing circumstances, the result they anticipated was very improbable. They did not call to mind many previous abortive attempts to build railroads in Illinois by private and municipal subscriptions, and they granted charters wherever asked for within the limits of the State of Illinois, and in connection with these, authorized the taxation of counties and towns to aid in their construction. This course stimulated, to an extraordinary degree, the motives for starting new railroads; but it also produced a reckless and fatal want of economy in carrying them out. Railroad contractors and adventurers were everywhere found ready to take the county or town bonds at their face *with sufficient margin in prices.* Ten per cent. bonds (as good as gold), were sacrificed in the great markets for whatever New York brokers chose to offer them. They were sold at an average of more than 12 per cent. discount. As a general rule, these subscriptions were for grading and ties, and did not embrace more than one-fifth of the cost of what is termed a first-class railroad. The right of way, the grading and ties, together with *the franchise* and all property whatever afterwards acquired, had to be mortgaged, and on this security railroad bonds were issued and offered for sale to the amount of from $15,000 to $20,000 per mile. If 75 per cent. in cash was realized, it was readily accepted; but in many cases it has been impossible to effect a sale at any rates; of course, if it was a desirable line, it might be, then, gobbled up by some prosperous railroad company in the vicinity. If, on the other hand, the new company succeed in selling at a discount, it has to struggle on under the pressure of a heavy bonded debt, paying from its net earnings the interest of $100 for every $75 in cash they have expended. And then it may be asked what have they got for their $75? They have *half built a first-class railroad.*

In other cases, new companies have been organized, surveys have been made, much time and money expended in soliciting support, and when by the aid of municipal subscriptions the people might have had some chance for competing roads, the provisions inaugurated by the Constitutional Convention, much of the character of an *ex post facto* law, crippled their efforts, and now a subsequent General Assembly is about to finish the job!

If the construction of railroads was not based upon the ruinous system of borrowing money at ruinous rates; if the people were aware of the true means by which competition could be effected, there would have been no objection to municipal subscriptions, because the whole of the property of the railroad would have been security for their payment. They would have completed with their own money cheap tracks and would have operated them with light rolling stock. They would not have needed legislative interference.

The narrow gauge, with all its inconveniences, would have effected the object. The narrow gauge, however, is only one step toward a remedy for the acknowledged defects of the present railroad system. The principal advantages derived from its partial introduction, so far, have arisen not so much from its intrinsic merits as from the stupendous losses sustained by ordinary railroads in carrying useless dead weight. The Chicago, Burlington & Quincy Railroad transports from 800,000 to 900,000 tons of freight annually, and carries with it, including locomotive engines, more than an equal amount of dead weight. Reduce this 25 per cent. (which is quite practicable in stocking a new road), and the net earnings of that company on freight would be increased more than $500,000 annually.

With passengers, the proportion of dead weight to paying weight is vastly more, and is caused by the efforts of railroad companies to secure for the traveling public the luxury and comfort they require. In this case, as well as with freight, an immense saving is practicable.

The present Legislature is expected to do something to correct abuses and so diminish the cost of transportation on railroads generally. Whatever it does by meddling with the management of railroads, either by establishing a maximum for charges or equalizing the same, is damaging to the public interests. To fix a sliding scale, according to the success or the contrary, of different railroad companies is as unjust as it is absurd. One company may by good management realize small profit on an indifferent line of railroad, whilst another may be calling for indemnity from restrictions which its own incapacity has rendered it unable to pay. Every restrictive law shuts out capital that might otherwise be invested in extending the facilities of railroads wherever needed.

If our General Assembly would pass a general railroad law encouraging to enterprise, and, instead of restrictions, would pay a bonus for every reduction in the cost of construction as well as in the operating expenses and cost of maintenance of way of any new railroad, as compared with present system, it would be adding more to the prosperity of the community than they are at all likely to do, especially by the repudiation of vested rights.

R. P. MORGAN.

ACTION OF LEAD FILLING IN PIPE JOINTS.

In examining a water-supply pipe lately, I noticed some phenomena in connection with the lead filling of the joints, the causes of which I do not remember to have seen explained.

The pipe is a four-inch hub and spigot joint cast-iron pipe, in lengths of twelve feet, intended to be used in forcing water from the Smoky Hill River to Wallace Station, on the Kansas Pacific Railway, a distance of seven thousand feet.

The pipe was laid in general conformity with the surface of the ground.

The joints were leaded, and the pipe was left exposed. After some time it was observed that at many of the joints the lead was forced out of the joint. Examination showed that it was only in those parts of the pipe where the hub end of a length was lower than the spigot end that the lead was forced out of the joint.

In no case where the hub end was inclined upward was any movement of the lead detected. It occurred to me that this might be explained on the principle involved in the following illustration:

If a bar of lead be placed upon a plane surface of iron inclined at an angle less than the limiting angle of resistance between lead and iron, and exposed to changes of temperature, the lead will move gradually down the incline; since, when the temperature rises and expansion takes place, the lineal expansion of lead between 32° and 212° F. being 1 in 351, while that of iron is but 1 in 846, the effort of the lead to extend tends to push the upper end of the bar up the incline and the lower end down. But gravity assists the extending force down the plane and the movemement takes place in that direction, *i. e.*, in the direction of the least resistance.

Upon reflection it will be apparent that contraction of the lead due to a fall in temperature will in like manner produce motion down the plane. Thus every variation of temperature causes the center of gravity of the bar of lead to move down the plane.

In the same manner the lead moves down the inclined joints of the pipe, the fact of the lead being inclosed evidently not affecting the result.

If the conclusion be correct, it would indicate that lead filling might be used to advantage in exposed pipe, where the pipe could be laid in such manner as to bring the hub end higher than the spigot end, since the tendency of the lead in that case would be to ensconce itself in the joint; but where the converse is the case, some device would have to be adopted to prevent the movement of the lead, as explained. C. R. S.

RAILROAD GAZETTE

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Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the Railroad Public in affording us the material for a thorough and worthy Railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Inventions.—Those who wish to make their inventions known to railroad men can have them fully described in the RAILROAD GAZETTE, *if not previously published,* FREE OF CHARGE. *They are invited to send us drawings or models and specifications. When engravings are necessary the inventor is expected to furnish his own engravings or to pay for them.*

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

Engineering and Mechanics.—Mr. M. N. Forney, Mechanical Engineer, whose office is at Room 7, No. 72 Broadway, New York, has been engaged as Associate Editor of this journal in charge of these departments. He is also authorized to act as our agent.

Removal.—About the first of February next the office of the Railroad Gazette will be removed to Nos. 110 *and* 112 *Madison Street.*

☞ *Our Prospectus and Business Notices will be found on the last page.*

THE GAUGES AGAIN.

We have before us several statements, which have originated on this side of the Atlantic, of the relative cost of wide and narrow-gauge railroads. As such "statements" are now very current in the daily and many of our technical papers, and as they are accepted by many people who have not examined the data on which they are based, and as there is a probability that much capital may soon be invested on such representations, some examination of them may not be amiss. The following correspondence, which we have cut from an exchange, is an example of the kind of estimates which are now so often made of the cost of the narrow-gauge roads.

"The Toledo *Commercial* having stated that the Piqua, St. Mary's & Celina Railway Company had been incorporated on a capital basis of $400,000—to build a line between Piqua and Celina, through Miami, Shelby, Auglaize, and Mercer counties, Ohio, about forty-four miles—a Piqua correspondent gives us the following details of the scheme:

"'The country along the line is very populous and productive, and the question of an outlet by railway has long been agitated. But the Miami & Erie Canal passes through it already; and while inadequate to the wants of the country, there is scarcely warrant for the construction of an expensive road. Last winter the plan of a narrow-gauge road was proposed and discussed, costing, fully equipped, less than half a million of dollars, in place of one of the ordinary gauge, costing a million and a half. The design is identical with that of the Welsh railways, which have been so often described in engineering journals of late. A road of this kind for transporting coal is already in operation (the only one in this country as yet) between Akron and Massillon, Ohio. A system of narrow-gauge railways is also projected from Toronto, Canada, as feeders to the wide-gauge roads now centering there. We learn that parties interested in the proposed Buffalo & Springville Railway are now examining the Canada system, with a view to the adoption of the narrow gauge. The Kansas and Denver Pacific companies also contemplate reaching the mining regions near Denver, and probably at no distant day penetrating the great mountain parks, and passing over the entire range by narrow-gauge roads costing only one-seventh as much as the present gauge, where the latter is practicable. In all these cases the *data* showing the entire practicability of these roads, and giving the cost and construction of operation, are such as to reduce the prospects of any such enterprise to a certainty.

"'To return to the Ohio railway. The right of way is to be 15 feet, in place of 40 feet; 20 lbs. instead of 56 lbs. iron will be required; the locomotives, weighing six tons instead of thirty, will draw from ten to twenty loaded freight cars, each having a capacity of 2½ tons; under freight and passenger cars alike (the latter seating twenty persons) four-wheel trucks will be placed; the ties will, of course, be nearer than on the wide gauge; while, finally, on account of the lightness of car equipment in comparison with capacity, and of the central position of the trucks, both higher gradients and sharper curves are practicable, greatly reducing cost of excavation and other important items of construction.'"

This statement is probably destined to be copied by many of our daily contemporaries, and may furnish the occasion for long editorials on the advantages of narrow over wide-gauge roads. Searching analysis into the accuracy of estimates for engineering work is not a common characteristic of the ordinary newspaper correspondent, but it does seem a little wild for even such an individual to say in the same paragraph that "a narrow-gauge road will cost less than half a million of dollars, in place of one of the ordinary gauge, "costing a million and a half," and, that, "narrow-"gauge roads cost only one-seventh as much as the "present gauge."

The way in which he makes his estimates certainly is peculiar. In the first place the right of way for the one road shall be 15 feet in place of 40 for the other. He does not explain how, or why, placing the rails from one to two feet nearer together should make a difference of 25 feet in the width of the right of way, nor why it is possible to lay down 20-lb. rails when they are near together and impossible when they are farther apart, nor why the engines and cars are preordained to weigh five times as much on the one road as on the other.

A paragraph which was copied into the RAILROAD GAZETTE of December 3 says: "A party consisting of the President of the Buffalo & Springville Railroad Company and others, lately visited the Toronto, Grey & Bruce Railway, in Canada, to examine the working of the narrow gauge and get figures as to the cost of construction. They present the following comparative statement of the cost of permanent way on narrow and broad-gauge roads:

FIVE FEET SIX INCH GAUGE.

100 tons of rails at $50 per ton	$5,000 00
Fish plates, bolts and spikes	800 00
Sleepers, 2,263	700 00
Ballast, 3,000 cubic yards	1,200 00
Tracklaying	400 00
Total	$8,100 00

THREE FEET SIX INCH LINE.

60 tons rails at $50 per ton	$3,000 00
Fish plates, bolts and spikes	400 00
Sleepers, 2,263	500 00
Ballast, 2,250 cubic yards	900 00
Tracklaying	300 00
Total	$5,100 00

Now observe first, that the comparison is between a 5 ft. 6 in. and a 3 ft. 6 in. gauge. Of course the difference between a 4 ft. 8 in. and a 3 ft. 6 in. line would be less than that shown. But taking the comparison as it stands, and if the same kind of iron were put down *in both cases*, we would have the following "comparative statement":

	5 ft. 6 in. line.	3 ft. 6 in. line.
Rails	$3,000	$3,000
Fish plates, bolts and spikes	400	400
Sleepers	700	500
Ballast	1,200	900
Tracklaying	400	300
Total	$5,700	$5,100

Or a difference of $600 instead of $3,000 per mile in the cost of permanent way, exclusive of grading. If the comparison was made with 4 ft. 8 in. line instead of 5 ft. 6 in., the difference would be reduced to about one-half the above sum, or to $300.

We have before us, also, a pamphlet which advocates the construction of narrow-gauge roads, in which the publisher says:

"In the first great item of cost, the moving of masses of earth and rock, we find a reduced amount [How much?] is required for a narrow gauge, not only because the embankments and cuttings are of less width, but we can introduce curves of shorter radius [Why?], and thus better adapt the line to the inequalities of surface, passing around, instead of cutting through the hills, thus securing easy gradients without expensive works, and at the same time effecting a saving in the cost of the right of way, by lessening and avoiding the damage to private property.

"By reason of the reduced gauge, a lighter iron rail could be used, [Why?] an important consideration when iron is from $80 to $85 per ton, so that a reduction of weight from seventy to thirty pounds per yard would amount to five thousand dollars per mile.

"This saving of first cost would extend, to a greater or less extent, to every item that now swells the expense of construction, such as cross-ties, ballasting, bridging, culverts and masonry.

"The cost of the equipment, the engines, cars, and machinery would be less in a marked degree [How much?] as we would be enabled to use locomotives costing from four to seven thousand dollars, instead of those costing from twelve to fifteen thousand dollars. [Why?]

"And when we consider the shifts that are resorted to, to obtain the necessary capital, the discounts of brokers, agents, and middlemen, we can see where, by reducing the amount of capital required, we can avoid the loss sustained in that direction.

"So, too, when we can raise it to a paying enterprise can we secure better materials and more perfect workmanship.

"By reason of this superior construction and of the reduced gauge, we may effect a saving in the cost of the repairs of the roadway, etc., thus reducing the percentage of expenses; but this is of little importance compared with the advantages we have enumerated in the saving of original cost, wherein the great merit of the narrow gauge consists and the ground upon which we advocate its introduction."

In making this quotation we have taken the liberty of interpolating some parenthetical questions, which we do not find answered in the pamphlet. We have in it the same reasoning that has been adopted by the advocates of the narrow gauges on both sides of the Atlantic. It is constantly asserted by them that the cost of a railroad with the rails near together will be much less on that account. The proportion which the cost bears to the distance apart of the rails is not yet clearly established in the minds of these "advanced" engineers. One of the leading advocates of narrow-gauge roads says: "Taking the average, the cost will "vary as the gauge." One of the writers above obviously is not clear in his mind about it, for he says that in Ohio such a road will cost only one-third as much as one of a wide gauge, whereas roads "penetrating the "great mountain parks will cost only *one-seventh as much*."

That the cost will be somewhat less if the rails are near together we of course will not deny; but it will not be in proportion to the gauge. In grading for either a wide or narrow road, the embankments and excavations must be made with the same slopes for either gauge, and they—the slopes—will cost the same whether the rails are six inches or six feet apart. The roadway for a wide gauge, after the sides of the cuts and fills are once formed, will, on account of its greater width, be more expensive than a narrow gauge, but the *proportion* of their cost will be considerably *less* than the proportion of the distance between the rails, because it is only the amount of material to be moved in widening the roadway after the slopes have been formed that will count in favor of the narrow gauge.

We do not, of course, intend to say that there are not circumstances in which it will be an advantage to have the rails near together. A coal mine is an example where it would be impossible to place them far apart. Other exceptional cases and circumstances may occur, such as a temporary road for excavating and transporting earth. What we do assert, and that very earnestly, is that light railroads of 4 ft. 8½ in. gauge can be built and equipped with light cars and engines of the same character as those used on the narrow roads and at a cost very little above that of a road which is contracted in gauge and contracted in accommodations. It is obviously not a fair comparison of the cost of roads to assume that the rolling stock for the narrow road may be so much lighter than for the wide gauge, and therefore that the saving in iron and the bridges, and finally, as in the pamphlet quoted above, that in the discounts charged by "brokers, agents and middlemen," is to be attributed to the "superiority" of the narrow gauge. In fact, some of the people who advocate the narrow-gauge often seem to get into a state of confusion about the *causes* of the great economy they preach. They will assert at one time that the rails need not be heavy because the rolling stock is light; then that the rolling stock is light because the substructure is not heavy. Their reasoning sometimes reminds one of the man who was so short that he never could tell whether his head ached or his corns hurt him. They sometimes argue in favor of light roads and then of narrow gauges. Light roads are one thing and narrow gauges quite another. You can have the one with all the advantages, without the other with its disadvantages. Mr. Fairlie, the great apostle of narrow-gauges, has recently shifted his ground somewhat by asserting "That the great element "in the gauge question does not depend so much on the "reduction which could be made by any means what-"ever in the weight of the present rolling stock as the "reduction of the capacity itself." If the merits of the discussion should narrow down to this question of capacity of the rolling stock, then surely there will be

no trouble in making cars to carry as little freight or as few passengers as may be desired, and that, too, without increasing the proportion of the dead to paying weight. But then it would become a discussion on the merits of light railroads and not a question of gauges.

The advocates of the narrowgauge assert, what is perfectly true, that for a light traffic a railroad much lighter than is required for a heavy traffic will be more economical. They then, however, fall into error in assuming that in order to have a light road a narrow-gauge is necessary. Their reasoning stated logically is like this: "Railroads with light rolling stock are more economical than those with heavy cars and engines. Narrow-gauge roads have light cars and engines; therefore, narrow-gauge roads are more economical than those with a wide gauge." The fallacy consists in the assumption which these people constantly fall into, that only narrow-gauge roads can have light rolling-stock, which is not true. Take as an example an ordinary horse railroad for transporting passengers. They are nearly all of 4 ft. 8½ in. gauge, and yet their cars and entire equipment, we venture to say, are lighter, if estimated by the proportion of dead to paying weight carried, than those on any narrow-gauge road ever built. In the suburbs of many of our larger towns and cities there are examples of such roads which are laid with light rails and have light cars, which are hauled by small four-wheeled engines at a speed often of twenty miles per hour, and that with four-wheeled cars which are not suited for a high speed on roads with sharp curves. The difference in cost of a 4 ft. 8½ in. gauge road over one with the rails 3 ft. apart, when all the other conditions are the same, is only that which is due to the slight difference of the expense in grading, and in the cross-ties, with perhaps in some cases an additional expense in the right of way, which in this country is not usually an important item. The inconvenience which *must* result from a break of gauge will much more than offset the difference in expense, and the fact that all branch roads, in new countries especially, may in the great majority of cases reasonably expect to develop in time a business which would require a wide-gauge road to accommodate it, alone seems a sufficient reason for adopting the ordinary distance between the rails. Light and cheap roads and rolling stock can be built with a 4 ft. 8½ in. gauge and will accommodate almost any traffic better than a narrow gauge. If a branch road is built with a 4 ft. 8½ in. gauge, as its business develops, the iron can gradually be increased in weight as it is renewed, the substructure be improved, and the rolling stock increased in capacity. In the meanwhile all the original light equipment could be gradually worn out without any special or sudden change being necessary; whereas with a narrow-gauge such a gradual change would be impossible, and, if made at all, would require *all* the rolling-stock to be replaced with other of entirely different construction. A road of this kind could be built and made to yield a revenue with a comparatively small investment of capital, and as the business developed it could be improved and its capacity increased.

Certainly in this country, where we now suffer so much inconvenience from so great a variety of gauges, it will be worth while to reflect carefully before we introduce several new ones, especially when the advantages to be gained therefrom seem so extremely doubtful.

HORSE CARS.

A correspondent of the New York *Times* writing from Albany says:

"Mr. O'Neill, of New York, presented a bill forbidding any railroad company in the city from stopping a car to take in passengers after all the seats are occupied, and compelling them to display a sign inscribed "all full" at all times when the seats are all occupied. The bill also forbids them to charge more than five cents fare below Sixty-fifth street, and requires them to run cars as often as once a minute. Suits for violation of the act are to be brought by the Attorney of the 'Society for the Prevention of Cruelty to Animals,' one-half of the fines to go to the treasury of said Society and the other half to the city. It is substantially the same bill that was introduced here in 1864, and defeated by a large majority. It was declared by its opponents at that time to be a bill to compel every man to walk home when he most desired to ride—viz., in inclement weather—as it would be utterly impossible for the cars, even though running every minute, to furnish seats to all who want them in such weather."

The objections which are made to this bill are doubtless well grounded, and the long suffering public would probably be the first to cry out against such restrictions. A person in a hurry will usually rather stand up in a car than wait for one in which there is room to sit down. Most people want to have the liberty of either standing or waiting as they choose. The bill referred to above would take away this privilege and allow only so many to ride as can get seats. Although this attempt at correcting what is a very gross evil in every city in the land obviously would not accomplish its purpose, nevertheless the practice of overcrowding horse cars needs reforming, and in some way by legislative compulsion; for with all respect for the power of moral suasion, we doubt whether the managers of city railroads could be influenced by it—in this direction we mean. The public has borne the injustice so long that, like all oppressed people, they finally have commenced to doubt whether they have any rights in the matter. The question of regulating the transportation of cattle has been before several of our legislatures, and we believe was discussed in Congress this winter, but hardly any attention is given to the accommodations for the transportation of human beings. To say that no stock drover would for a moment think of loading cattle as men women and children are every evening and every morning packed into the cars on the horse railroads of nearly every large town in the country, is simply to utter a truth and not a figure of speech. Men whose physical and nervous power is taxed daily in their business nearly to the limits of human endurance, weak women who give of their bone and muscle for daily bread, old and young, strong and infirm, are obliged each day to be robbed of their strength by standing up and clinging to the straps in the morning, and are further exhausted in the evening by the same process.

When the public surrenders to the railroad companies the exclusive right to run cars through the streets, it is with the implied understanding that the consideration is that the company is to do certain things, which are to carry passengers at a stipulated price. But carry them how? If they obliged those who ride to stand on their heads, obviously it would not be fulfilling the spirit of the contract. What is meant is, that passengers should be carried with a reasonable degree of comfort. To stand on one's feet for half an hour in a crowded box, is perhaps more endurable than to stand on one's head; but certainly the railroad companies have no right to inflict conditions on their passengers which legislatures are now prohibiting those who transport oxen and sheep and hogs from inflicting on those dumb creatures.

When a railroad company does not furnish you or me with a seat, and obliges us to stand up, it is robbing us of just that much strength and comfort, an equivalent for which we pay them. It will not do for them to say that we need not get on if the car is full. That is not true, because we know and they know that at certain hours of the day it is utterly impossible to get a car which is not full. We *must* either get into a full car or else walk, and the railroad company is in justice bound to carry with reasonable comfort all who desire to ride.

It is said that at certain hours of the day and in inclement weather it is impossible to furnish cars enough to seat all the passengers. If this is true (which is doubtful), then the company is in the position of being unable to give full value in return for the fare paid them; because, obviously, if you are obliged to stand up you do not get as much, or rather what you value as much, for your money, as the person does who has a seat; therefore, it would be perfectly just not to allow any railroad company to collect full fare unless it furnished the passenger with a seat. It has been suggested that some relief might be obtained by the enactment of a law prohibiting, under proper penalties, *any* railroad company *from collecting more than half fare, unless it provides the passenger with a seat* ON DEMAND. It is urged that this would be just to the passenger, and no injustice to the company, and would be some spur to the latter to furnish better accommodations to those who are so unfortunate as to be obliged to ride in their cars. At the same time it would not take away a person's liberty of standing up if he prefers it to waiting, while it would be some slight comfort for an aching back or a soured temper to know that the ride cost only three cents instead of five or six. If the street railroads are bound to furnish transportation only, without respect to the comfort or discomfort of the cars, we may yet see them stocked entirely with open platform cars with pine benches, or, should the benches be considered objectionable "dead weight," the platform with a railing simply might be more economical, and then, at least, we should get pure air. The principal difference would be that we should have open pens of human beings instead of the close pens we are carried in now.

The South & North Alabama Railroad Company.

This company has been in existence for the past thirteen years, but until within the last two years it has had no road to operate. Its line will, when completed, pass from north to south through the center of the northern half of the State of Alabama, terminating at Decatur on the north and Montgomery on the south, and passing through a rich and, as yet, undeveloped coal region. At the present time the track is laid on ninety-five of the one hundred and eighty-three miles, and the grading is substantially completed on twenty-five miles more, leaving sixty-three miles of grading and eighty-eight miles of track-laying yet to do. The company have conducted the work in two divisions, keeping the accounts entirely separate; on the southern division having advanced from Montgomery northward sixty-three miles, to Calera, on the Selma, Rome & Dalton Railroad. Trains have been running regularly on this division since September last. On the northern division the character of the work has prevented its rapid progress; the bridge over the Alabama river causing considerable delay, as well as a more serious obstacle being met with twenty-three miles south of Decatur, where the road commences the ascent of the sand mountain, and in a distance of six miles is encountered the heaviest work on the whole line. Nearly all the work done in this division during the past year has been confined to this six miles. North of Calera some rough country has been found at Brock's Gap, where much work has been done and but little advancement effected.

The completion of this road will open another route from New York to New Orleans, *via* Montgomery, which, it is claimed, will be shorter even than the Alabama & Chattanooga line, when that road is finished to Meridian.

It will likewise open a new and shorter line from the North—Cincinnati, Louisville, St. Louis and Chicago—to the interior Alabama, and a good short route—to some of these towns the best and shortest—to the Gulf at Pensacola and Mobile, as it connects directly at Decatur with the Nashville & Decatur line, and through it to the various lines from Nashville.

At the late annual stockholders' meeting, the directors elected were: F. M. Gilmer, Jr., Josiah Morris, Bolling Hall, J. P. Stow, H. E. Faber, W. G. Farley, J. R. Powell, E. R. Mitchell, Charles Linn, W. S. Bibb, J. T. Tanner, Luke Pryor, and Z. Freeman. Of these, Messrs. Faber, Powell, Mitchell, Linn and Pryor are new members of the board. The officers for the coming year are: F. M. Gilmer, Jr., President; John T. Milner, Engineer and General Superintendent; T. B. Maddox, Secretary; and Henry M. Bush, Auditor and Bookkeeper.

The Last Report of the Erie Railway Company.

The Erie Company has made a report of earnings and expenses for the year ending September 30, 1870, to the State Engineer of New York, as required by law. The figures, as reported by telegraph, are as follows:

From passenger trains	$3,968,609 82
From freight trains	11,983,547 06
From other sources	227,014 74
Total	$16,179,171 62
PAYMENTS FOR THE YEAR OTHER THAN FOR CONSTRUCTION.	
Transportation expenses	$12,073,010 89
Hudson River Ferry	235,957 44
Operating telegraph	110,099 19
Interest on funded debt	1,646,653 00
Rents	1,089,351 79
Internal revenue tax	83,417 28
Interest	264,[illegible]43 55
Operating Twenty-third Street Ferry	32,983 46
Operating sundry branches	25[illegible],360 21
Hire of cars	18,578 28
Sundries	280,637 41
Operating Atlantic & Great Western Railway	386,470 50
Total expenses	$16,471,518 00

Thus it appears that, notwithstanding the enormous receipts and the still more enormous traffic, the Erie Company lost the trifle of $300,000 during the year. This is unfortunate; for should these losses continue, and the road be unable to earn its operating expenses, it is evident that it will be compelled to borrow money to pay for supplies and labor, and, as the heartless capitalists will doubtless refuse to lend money to sustain a losing business, the burden of sustaining the line will fall upon the managers, whose pride in the line they have managed so brilliantly is so great that they would doubtless sacrifice a large part of their private incomes in order to keep the line in operation and continue to accommodate the public over the broad way that leads to New York. But we hope for better things. Should the managers of the rival lines carry out their agreement to sustain rates hereafter, and in the future refuse to cut rates in a headlong competition for business, then we may resonably expect that the Erie during the current year will earn sufficient to meet *all* its operating expenses, and very likely a surplus sufficient to make great improvements on the road, rolling stock, stations, etc., so that it may safely defy the world, as it now does America, to show its equal.

It must be very gratifying to a certain class of statesmen and economists to see how admirably this company has succeeded in preventing any considerable diversion of its vast earnings to citizens of the "effete "despotisms of Europe," although, it is currently re-

ported, a considerable portion and perhaps a majority of the shares of the company are held by such citizens. Doubtless the aforesaid statesmen will observe with much pleasure that all of its earnings *and three hundred thousand dollars more* were disbursed in our own free America, where all men are equal, where privileged classes are unknown, and where every man, black and white, native and alien, is protected in his rights of person and of property by just laws and an independent, incorruptible judiciary. (We beg pardon for inserting a little Fourth-of-July oratory just here, but the subject seemed to demand it.)

By the way, no report of the amount of business over the line is given here, but we desire to call attention to the fact that it must have been much larger then than the report of earnings would indicate, for during that half of the year when business was heaviest, the rates were lower than ever before known. This was especially the case with freight, and yet we see that the Erie Company received very nearly *twelve millions* of dollars for the transportation of freight alone. This, to be sure, is half a million less than the freight earnings reported for the previous year; but as during the last year cattle were carried from Buffalo to New York for one dollar per car load for some time, and other freights one-quarter, one-fifth or one-sixth of the usual rates, it is evident that there must have been a very lively movement of trains to earn even twelve millions.

We hope that no one will make investments in Erie stock on the strength of the statements made above. As we have said, the figures came by telegraph, and their original veracity may have been falsified in transmission, the telegraph not being always exactly accurate, and peculiarly liable to err, just as types are, where figures are concerned. In a few days we shall have the report by mail, and that is likely to be more correct. Some, however, may prefer to wait until the official report is published before they make any very large purchases for investment, and perhaps that would be quite as well. This report we will probably receive next August or September, and all capitalists contemplating making purchases of Erie stock will cheerfully be granted permission to examine it.

Palace Street Cars.

The directors of the Third Avenue Street Railroad Company, of New York, propose to run a certain number of clean and elegant cars, equal in comfort to private carriages, between the City Hall and Harlem, provided they can prevail on the Legislature to permit them to charge a higher fare for the better accommodations. Only so many passengers would be admitted as could be seated in the car, the directors say, and this alone would be sufficient to make many willing to pay double the present rate. There is no reason why a street car cannot be made one of the most elegant and comfortable of vehicles. It can be upholstered and adorned as easily as a carriage or a drawing-room car, and provision might he made for heating it; but of course the comforts of a parlor cannot be provided in a car carrying 50 or 60 persons, and drawn by two horses. But if people are willing to pay for the accommodations, they can have as good as they can desire on a street railroad. And such accommodations may, perhaps, be furnished at a cheap rate, after we have learned how to dispense with horses on these city lines. But there is a considerable class which will never be accommodated by a very cheap carriage, for the reason that it will not exclude *hoi polloi*, or the "great unwashed," as the moderns express it.

The Massachusetts Report.

In this number we publish the last and concluding portion of that part of the report of the Railroad Commissioners of Massachusetts which treats of those questions which arise out of the relations of the community and the railroads. We have never before seen the subject treated with such fairness, fullness of information and acuteness. It is refreshing to find a body of officers who have consented to study this subject and are disposed to base legislation on ascertained facts rather than crude guesses. It is also encouraging to find that these commissioners, who are probably better qualified than any other body of men to direct legislation on the subject, do not offer their suggestions as positive remedies for the evils complained of, but as measures worthy of trial and likely to produce good results. On the frontier there is a popular saying, "Go slow," which in some things where it is most applicable seems to be better observed in Massachusetts than in Illinois.

We have now neither time nor room to discuss the recommendations in this report. The most striking—the proposition that the State should buy and operate the Fitchburg Railroad—is so novel, in purpose if not in form, that it is not easy to conjecture its effect. Whether it should succeed or fail, however, doubtless the experiment would be very instructive, and for that reason, at least, it would gratify us to see it tried. We have not much faith that even Massachusetts would operate a line well, even through a board of trustees. If it should, the result might be really harmful outside of that State; for most of us will confess that Massachusetts might do what no other State can and what the General Government would be sure to fail in most grievously, unless a radical change is effected in our civil service.

But the report is worthy of the careful attention of all who think on the subject and especially of legislators, who will find it exceedingly suggestive and valuable for its warnings as well as its instruction. These and others interested in the subject, we are authorized to say, can obtain copies of the report by sending a request for the same to the Board at No. 7 Pemberton Square, Boston.

Atchison Railroads.

Two weeks ago, under the head of "Great Railroad Centers," we made some comments on what we regarded as an exaggerated statement of the railroad connections of Atchison. A correspondent so far misapprehends us as to say that we "claimed there was no "railroad depot in Atchison, only the one on the op-"posite side of the river." Begging his pardon, we said nothing of the kind. We said that the Atchison newspaper article claimed that Atchison was the "termi-"nus of three railroads with 758 miles of line which "have not even a station in Atchison." This is quite true. The three railroads are the Kansas City, Council Bluffs & St. Joseph, which has a station just across the river in Missouri, the Hannibal & St. Joseph, whose nearest station is at St. Joseph, 20 miles to the north east, and the North Missouri, which has one station on the main line at Kansas City, 50 miles below and another on a branch at St. Joseph, 20 miles above. But we did not in any way intimate that the place had no railroad terminus or station. Indeed we expressly mentioned certain lines to the West as likely to be of the greatest value to it. There are three railroads in operation which have terminal stations in Atchison, and it has close connections with the Kansas City, St. Joseph & Council Bluffs Railroad through the transfer boat which carries loaded cars across the Missouri. Because too much has been claimed for the town, it by no means follows that it has nothing.

The Fuller Bill in the Senate.

The bill to restrict railroad companies in Illinois to a charge of three cents per mile for carrying passengers, which was recommitted to the Committee on Railroads last week, together with a proposed amendment by which railroads were to be divided into three classes with the limit respectively, of three four, and five cents per mile, was reported back to the Senate by the committee last Wednesday with the recommendation that the amendment be not adopted. This report was concurred in. Mr. Underwood and Mr. Epler made a strong effort to have a higher rate permitted to the shorter roads, but all in vain, and it is believed that all such efforts will be in vain and the bill passed in its present form. Mr. Underwood urged the appointment of a commission with authority to fix maximum rates, substantially as proposed by Mr. Charles F. Adams, Jr., in the *North American Review* article which we published a few weeks ago. Mr. Underwood is better informed on railroad business than almost any other member of the Senate, has good judgment, admirable tact, and commands universal respect in the Legislature; and if he had begun earlier and worked half as energetically as Mr. Fuller, he would be quite likely to carry his point. Very likely he may make a greater impression in the House than the Senate, where a large part of the members are in a manner committed to the Fuller bill.

REGISTER OF EARNINGS.

FOR THE SECOND WEEK IN JANUARY.

Michigan Central (463 miles), 1871	$111,212 13
" " (329 miles), 1870	74,257 15
Increase (33¼ per cent.)	$36,954 98
Chicago & Alton (465 miles), 1871	$85,689 78
" " (431 miles), 1870	69,199 01
Increase (24 per cent.)	$16,470 05
St. Louis & Iron Mountain (210 miles), 1871	$34,487 00
" " " (210 miles), 1870	23,361 00
Increase (47⅝ per cent.)	$11,126 00

FOR THE THIRD WEEK IN JANUARY.

Michigan Central (284 miles), 1871	$70,593 11
" " (284 miles), 1870	69,607 31
Increase (1⅖ per cent.)	$ 985 80
[These earnings are for the main line only.]	
Chicago & Alton (465 miles), 1871	$78,726 36
" " (491 miles), 1870	68,234 72
Increase (15⅜ per cent.)	$10,491 64

THE EFFECT OF SEVERE COLD UPON IRON AND STEEL USED ON RAILROADS.

If any American engineer were requested to make a report on this subject, he would find it extremely difficult to get any accurate data in relation to it. There is a general impression abroad that iron and steel are more brittle when cold than at a higher temperature, but we doubt whether in most cases this idea is based on any other knowledge than the most casual observation. We have before us a copy of a report made to a European government by a scientific agent respecting the influence of the cold in Russia upon iron and steel in the form of railway plant. There are some things in this report which our American practice and experience will controvert, but nevertheless it contains much information which is obviously the result of careful observation and inquiry. Of the Moscow line the writer says:

"The road is generally flat, the heaviest gradient being 8 in 1,000. It is laid with good ballast, but is badly drained. The character of the ballast forms an important consideration in the structure of roads for cold climates; indeed, it may be said that coarse ballast and good drainage form the only practical means of giving sufficient elasticity to the road. Good drainage is, of course, of prime importance, since the accumulated water would in freezing form a solid road.

"The Finland line is well drained, and the ballast laid down is never smaller than hemp-seed. It has been attempted to give elasticity to the road on this line by interposing between the sleepers and the rails a layer of felt formed of cow hair, and saturated with coal tar, but this device has been found more successful in preserving the sleepers than in its original object of giving increased elasticity to the road. The same experiment has been tried on the Taff Vale Railway in South Wales, and has been attended with the same results.

"The sleepers employed are made of fir and pine wood, and are not steeped in any preservative solution. They are laid 3 ft. apart, each rail being about 21 ft. long, and supported by seven sleepers. A five-foot gauge is usually employed. The fish-plates are 18 in. long and ¾ in. thick; and sole-plates or base-plates are also used. The rails are fastened with dog-spikes.

"In Canada, where the climate is as severe as in Russia, the state of the road is maintained by laying the rails loose, so as to leave between them and the sleepers a space into which pieces of wood are inserted on the approach of winter, and removed in the spring. This practice has also been followed on the Moscow and Warsaw lines, in the same manner as in Sweden; but has not been introduced on the Finland Railway.

"*The Rails.*—Iron rails of flange section weighing 72 lbs. per yard are generally used. These are supplied by England and Belgium. Unfortunately the breakage of rails is often extremely disastrous. Thus, on the Moscow line, it happened that in the winter of 1866 a single train in its journey from Moscow to St. Petersburg broke not fewer than fifty-nine rails, and thus stopped the traffic for several days. * * * The slabs stipulated for in the specifications are 1½ in. thick; and the rails are submitted to two tests for strength—the one being the power of sustaining a dead weight of 30 tons, and the other the power of resisting the concussion of a ball of 10 cwt. falling from a height of 10 ft. * * * * *

"The breakages generally occur in the spring of the year, but it must be admitted that in wear the rails are put to very severe test; the passenger-cars, which are constructed on the American principle, weighing 30 tons each, and the express traveling at a speed of twenty-eight miles per hour. It may be said that the causes of frequent fracture are referable to the inferior quality of the rails, to the bad drainage of the road, to the use of cast-iron wheels not turned, and to the want of homogeneity in the structure of the iron.

"As the remarks made above apply only to the Moscow line, it should be noted that on the Warsaw line the test for concussion was formerly somewhat different. At one time it consisted in exposing the rail to the shock of a weight of 6 cwt. falling through a space of 7 ft., but as this was found to be too mild a test, it has been increased to a weight of 10 cwt. falling through 10 ft.

* * * * * * * * *

"*Steel Rails* have been used at stations on both the Moscow and Warsaw lines. On the Moscow Railway the traffic is so heavy that it is proposed to substitute steel for iron throughout the line, a change which has been already commenced. The steel rails used by this company are submitted to the test of a weight of 1 ton falling from a height of 18 ft. Only two cases of the breakage of steel rails have been recorded, and these were in the middle of an incline with a gradient of 8 in 1,000. Three years' experience in the use of steel on this

railway has led to a perfect confidence in its merits. It is considered that steel rails are safer than the iron rails of Cleveland, but not so secure as Welsh rails of the toughest description.

"The Warsaw Railway has also used steel rails made at Sheffield, by Cammel's and Brown's. The experience on this line extends over a space of two years, and is favorable to the introduction of steel.

"Owing to the smallness of the present traffic on the Finland line no steel rails have yet been laid down.

"Some experience has also been gained by Russia in the use of *steel-headed rails*. Heads of puddled steel and of Bessemer steel made of flat slabs have been used, but are found to wear badly, giving results hardly equal to those of new iron rails.

* * * * * * *

"*Rolling Stock—Wheels.*—On the Moscow line the wheels are of cast-iron, from 32 in. to 36 in. in diameter, and have been made on the American principle, by Winans & Co., formerly contractor to that line. They are not turned, and as it is impossible to make them perfectly round, they have given bad results, and are about entirely abandoned, wrought iron and wooden wheels being proposed as substitutes. There are larger establishments near St. Petersburg for the manufacture of these cast-iron wheels, where the best Swedish iron is used and great care taken in the manufacture. In spite, however, of this care, it is found that one-third of the wheels tried on the road are generally rejected, in consequence of cracks and other imperfections in the casting. It is instructive to note the difference respecting the use of cast iron gained in Russia, and in Canada and America; in the latter countries cast-iron wheels still enjoy a high reputation. Instead of cast iron it is intended to use wrought iron wheels for trucks, and Mansel's wooden wheels for passenger cars. The use of iron tires and axles has been generally abandoned—Bessemer's steel being substituted for carriages and wagons, and cast steel for engines. * * *

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CONCLUSION.

"There can be no doubt that iron and steel are very sensibly affected by changes of temperature, and the more extreme these changes are, and the more suddenly they are brought about, the greater will be the extent to which the strength of the material is affected. In support of this proposition I may state that in St. Petersburg, where the climate is more changable than in Moscow, the evil effects are more keenly felt, and the railway plant is much more subject to breakage. In St. Petersburg the temperature often changes from 0 deg. to 40 Centigrade, but in Moscow, when once the winter has set in, the cold is much more constant.

"Since great differences exist in the quality of iron, and in its power to resist any particular kind of strain, it behooves every railway engineer to select in any given case that kind of iron whose chemical composition shall best suit it to the special work in question, and also to study its mechanical properties, so that it may be adapted to the kind of work which it may have to perform. Thus, we find that the presence of phosphorus in iron has the most injurious effect when the metal is exposed to concussion at a low temperature, while its effects are by no means equally prejudicial to the tensile strength of the iron at the same temperature; hence, such metal, when exposed to severe cold, will break like cast iron under a blow, but may nevertheless be able to sustain the same dead load in winter as in summer.

"Styffe's theory, which refers the greater brittleness of iron in winter solely to the increased rigidity of the support on which the metal may rest, is contradicted by the experience gained in the Russian railways. * * * Doubtless the elasticity of the base on which the metal rests does considerably affect its strength, but even if the supports have the same elasticity in winter as in summer, as would be the case with a granite rock, it is found that the more phosphorus the iron contains the more readily will it break on exposure to concussion at a low temperature. Such iron should therefore be confined in its use chiefly to countries which enjoy a temperate climate, or should be applied to such objects as are not subjected to the effects of concussion, such as roofs, buildings, plates, etc. In a railway, however, it should be borne in mind that the road, when high speed is used, must be subjected to concussion as well as the rolling stock—a fact which is proved by the greater number of accidents which have occurred upon increasing the speed. Indeed, experience in Russia shows that the higher the speed, the more numerous are the breakages, these being consequent upon the sharper concussion due to increased speed. Both iron and steel may be regarded as composed of an assemblage of numerous small crystals, the cohesion between which—and, therefore, the strength of the metal—will be affected by the amount of phosphorus present; the effect of low temperature seems to be to lessen the cohesion between the component crystals, and hence the diminution of strength consequent upon reduction of temperature. Instead of entering upon any theoretical explanation of these phenomena, I prefer proceeding to the conclusions which may be legitimately deduced from the facts known to practical men, and which may be useful to the railway authorities in guarding against the disastrous effects of extreme cold. In stating these conclusions, it will be well to arrange them in the corresponding order to that given above, and to treat successively of the road, the rails, and the rolling stock.

THE ROAD.

"The great point in connection with the road is to secure effective drainage, and to have it well laid with good coarse ballast.

"The *sleepers* must be large and numerous, for the more wood that enters into the construction of the line, the greater will be its elasticity.

"The *rails* should be placed directly upon the sleepers, without the interposition of sole-plates, as these cause a shock to be communicated to the rolling stock at every joint. The joints should, if possible, be as stiff as the rails are in the middle, so that the road may become almost one continuous structure. * * * The rails should be made either of steel or iron, free from phosphorus. For their durability and safety, steel rails seem to have gained favor as much in Russia as in Canada.

"The Engineer-in-Chief of the Great Western Railway, of Canada, writes as follows: 'We have now a gross traffic of 2,250,000 tons per annum upon a single road, and cannot get iron rails to last over an average of four years, and hardly so long on heavy gradients. We are therefore now introducing steel rails of 65 lbs. per yard, and last autumn 1,000 tons were laid. Very soon after they were put down, about twenty bars broke, but we have had no breakages subsequently. This has been almost the universal experience gained on all American railways. Several rails break almost immediately, no doubt owing to slight imperfections, but after these first defects exhibit themselves, no further fractures take place. Steel rails, therefore, require equally as careful an inspection as iron rails.'

"Steel-headed rails are giving good results in America and in Sweden, and, therefore, the bad results obtained in Russia must be referred to inferiority of manufacture.

"*Iron rails* should not contain phosphorus, and should be tested by the inspector at the works by means of blows powerful enough to ensure safety. The Russian test of 6 cwt. falling through 7 feet on a 72-lb. rail has been found to be too mild, and rails which in England, at the works, have withstood such a shock, have broken during a Russian winter. On the other hand, the Swedish test of 15 cwt. falling 7 feet on a 66-lb. rail, has been sufficient to secure the railways of Scandinavia ever since their commencement from a single breakage of rails. * * * * * * * The question of determining a medium test having arisen among rail-makers, I have been led to adopt the following rule for the ball-test: *The weight of the ball expressed in cwts., multiplied into the height of the fall in feet, should be equal to the weight of the rail per yard.* Tests based on this method stand between the extremely severe Swedish method and the mild Russian test, and yet, according to my opinion, secure safety even in a cold climate. * * * * * "As there are frequent changes in the management of rail-mills, and in the quality of the iron employed, and as it may happen that a maker who deserves a good reputation one year may neglect the quality of his rails the next year, it does not appear expedient to arrange the different works in classes, according to the quality of rails produced, but it should rather be remembered that all makers can manufacture both good and bad rails; and if, therefore, railway engineers do not strictly look after their interest by careful inspection, they must naturally become sufferers.

* * * * * * * * * * *

"*Engines.*—Every portion must necessarily be of the best material and workmanship. Cast-steel seems to have gained general favor amongst Russian engineers; and is recommended both for safety and economy. * * * * There are, however, grounds for asserting that steel suffers less from the effect of cold than iron does, particularly if phosporus be present in the iron.

"Any means tending to confer *elasticity* on the rolling stock is certainly desirable, such as the use of india-rubber as extra springs, and of a large quantity of wood, rather than iron, in the rolling stock and permanent way. The slackening of the speed in winter seems advisable, both on the score of safety and economy."

Northern Pacific Railroad.

We learn that Judge Rice, the Vice-President of the Northern Pacific Railroad Company, who has been in this city and on the line of road for the past two months, has completed arrangements for the early construction of that part of the line of road lying between the Columbia River and Puget Sound.

Twenty-five miles, at least, of this road will be completed and in running order by the 1st of July next, and the balance at an early day thereafter. The Pacific Rolling Mills of this city have taken a contract for as many iron rails as they can furnish, and the remainder have been shipped at New York, and are now on their way to the Columbia River. A large force of men are already at work on the road, clearing off the timber and preparing for the graders, who are to follow in large numbers immediately.

Messrs. F. E. Canda & Co., of Chicago, have the contract for building this portion of the road, and the work will be pushed forward with all speed. Canda & Co. are also extensive contractors on the Northern Pacific Railroad, east of the mountains. Captain W. C. Walker, who has of late years acted as Superintendent of construction in the reclamation of tule lands in this State—Sherman Island in particular—and who is thoroughly qualified from experience to handle large bodies of men in such work, has been engaged, and will go forward in a few days and commence operations. A contract has just been effected in this city for two thousand Chinamen, who will be sent forward as fast as work can be provided for them. The calculation is to send two hundred on each steamer for Portland.

This part of the road will start at a point on the Columbia River about six miles above the mouth of the Cowlitz River, and following up the valley of the Cowlitz part of the distance reaches Olympia, the capital of Washington Territory, thus uniting the waters of Puget Sound with the Columbia by a line of road about 90 miles in extent.

The point of departure on the Columbia will be a place of considerable commercial importance. It has been named Kalama, and is located at the mouth of a clear mountain stream of that name, and is surrounded by wild and beautiful scenery. The ground rises gently from the river to a plateau now covered with a heavy growth of pine and fir, and commanding an extensive view of the river. It has a good water front, accessible at all times for the largest vessels and ocean steamers. Arrangements have already been made to erect the storehouses and offices of the company at this place, which, for the present, will be the headquarters of the company on this coast.

The town has been laid out by the company, and already there is a brisk demand for lots.

Judge Rice and his associates visited Olympia, Seattle, Whatcour, Port Townsend, Whildly Island, and other points of interest on Puget Sound.

By the construction of this link in the line, for which arrangements have been made, the waters of the Columbia, now actually navigated by steam for a distance of more than five hundred miles, and reaching from the Pacific Ocean to the base of the Rocky Mountains, together with the rich valley of the Wallamette, in which a road of nearly one hundred miles in length is now in successful operation, will be connected with Puget Sound and a system of inland navigable waters reaching to Sitka, a distance of more than thirteen hundred miles.—*San Francisco Alta California.*

PUBLISHER'S ANNOUNCEMENTS.

American Graphite Company.

The lubricating qualities of plumbago have long been known, but the presence of impurities in all that has heretofore been sold in the market has prevented its general use for lubrication. The above company, whose advertisement will be found in another column, claims to be able to produce by new processes, and with the aid of improved and expensive machinery designed especially for the purpose, perfectly pure plumbago. It also represents that the product of its mines, which are located at Ticonderoga, N. Y., possesses unctious or lubricating properties to a greater degree than any other yet offered for sale. It therefore offers to supply it to railroad companies and other parties of superior quality, pulverized to any degree of fineness, and of "*absolute, guaranteed and unequaled purity.*"

From our knowledge of the gentlemen who are managing this company, we feel fully justified in saying that railroad managers and others may rely on any representations coming from them.

Gill & Bidwell's Car Wheel Works.

We omitted a few weeks ago to call attention to this new establishment which has recently been completed in Pittsburgh, and of which Mr. Gill, formerly in the same business in Columbus, Ohio, is the superintendent. The *Iron World and Manufacturer*, of Pittsburgh, editorially remarks that, "to say that this firm will make a better wheel than the "Columbus firm, would, of course, not be believed; but we "can say without hesitation that they will make as good a "wheel." They will use the Hickley brand of Hanging Rock pig iron, which is said to possess qualities especially adapted to the manufacture of car wheels.

The present capacity of their foundry is 50 wheels per day; but they expect when it is completed to be able to turn out 150 wheels daily. The advertisement of these gentlemen will be found in another column.

—Mr. N. E. Scott, General Passenger and Ticket Agent of the Indianapolis, Bloomington & Western Railway, was lately visited at his office in Urbana by a party of editors from the vicinity, who presented him with a handsome cane.

SOME years ago, in New York, a turnpike-inspector imposed a penalty on a gate-keeper for keeping the gate open after he had ordered it closed. The fine was paid, but the gate-keeper subsequently instituted a suit to recover back the $10. The case has continued ever since, every year new issues arising, until at the present time, there are seventeen cases on the calendar of the Commission of Appeals, and sixteen more on the calendar of the general term—thirty-three in all. The expense of prosecuting these cases must have been hundreds, probably thousands, of dollars.

WANTS.

WANTED—A Master Mechanic, to take charge of the Brockville & Ottawa Railway Company's Machine Shops, at Brockville. None need apply without the best recommendations. H. ABBOTT, President.
BROCKVILLE, January, 1871.

AN ENGINEER, who has had nearly three years' experience in the use of the instruments, in railroad location and construction, wants a situation as assistant, either in Railroad or Mining Engineering. Address ASSISTANT, Gazette Office.

WANTED—A complete file of the RAILROAD ADVOCATE published in New York by Zerah Colburn about 15 years ago. A purchaser can be found by applying at this office personally or by letter.

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Portage, Winnebago & Superior Railroad.

NOTICE TO CONTRACTORS.

Proposals will be received at the office of Capt. D. W. WELLMAN, Chief Engineer, at Menasha, Wis., until

Twelve o'clock Noon, on Wednesday, March 1st, 1871,

for the Grading, Masonry and Bridging on that portion of the Portage, Winnebago & Superior Railroad lying between Doty Island and the Wisconsin River at Stevens' Point, a distance of about sixty-four (64) miles.

Proposals will be received for the work in each Section (of about one (1) mile), or for the whole work; but parties making proposals for the whole will be required to specify the prices for work on each Section.

Blank forms, setting forth the different items for which proposals will be received, will be furnished on application; and Plans, Profiles and Specifications can be seen on and after Monday, January 23d, at the office of the Chief Engineer, and at the office of the undersigned, in Ogden Building, corner Clark and Lake streets, Chicago, Ill., on and after Monday, February 6th, 1871.

Proposals, accompanied by Plans, are also invited for the Construction of the Railroad Bridge across Wolf River—to be either of Wood or Iron—consisting of one span of one hundred and fifty (150) feet, and one draw of sixty (60) feet, clear space. The bridge to be first class in every particular, and able to meet the requirements of a first-class road.

Separate proposals will also be received for the whole of the Span Bridging on the above-described work.

Right is reserved to reject all bids not deemed advantageous to the Company.

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CHICAGO, January 18, 1871.

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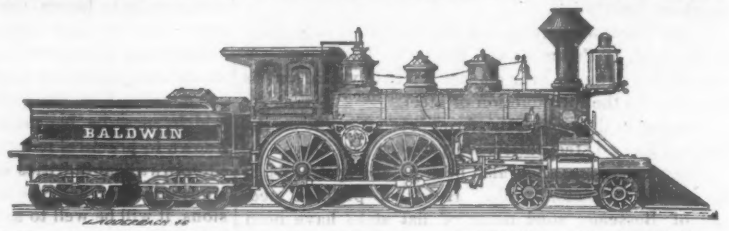

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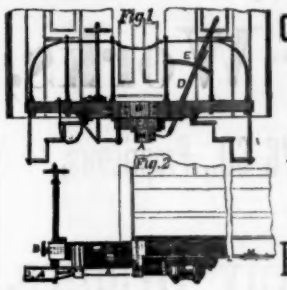

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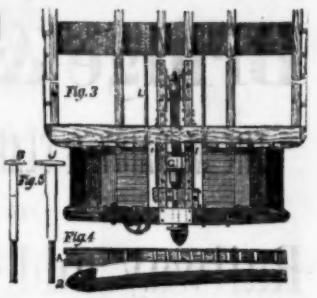

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2d. The platforms cannot be broken by any ordinary accident

3d. *Telescoping* is impossible.

4th. Any required compression may be attained, to prevent accidents by *oscillation*.

5th. No links and pins are required, and no one is required to go between cars to couple them.

6th. The platforms may be held as close together as desired.

7th. By close coupling the train is shortened.

8th. They will not accidentally uncouple.

9th. They may be uncoupled "*without shutting off*," to make a *flying switch*.

10th. They are strong; the train will not "*break in two*" at starting or while running.

11th. They cause the train to move steadily and not jerk in starting or stopping.

12th. They work well at great variations of hight.

13th. They will couple with all kinds of "draw-heads" and "couplers."

14th. They are cheap and durable.

15th. Injury to men when coupling cars is entirely prevented.

16th. Injury to persons by falling between cars is entirely prevented

17th. Injury to persons and to cars by "*telescoping*" is entirely prevented.

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19th. The great steadiness of the cars, *produced by compression*, render sleeping cars much more desirable.

20th. "*Train Brakes*" are rendered more valuable by the non-existence of "*slack*" in the train.

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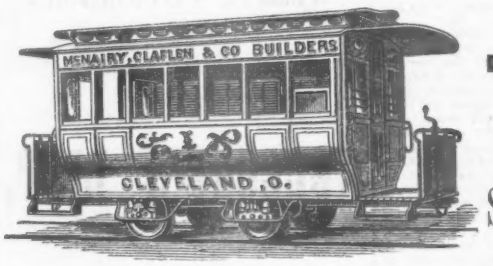

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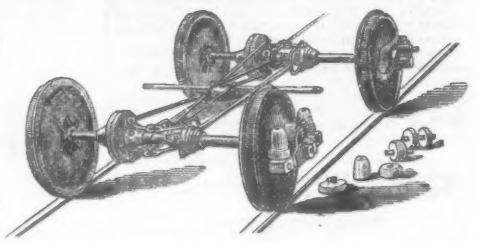

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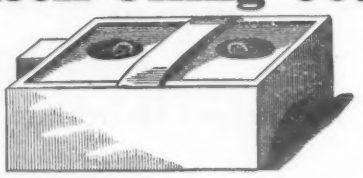
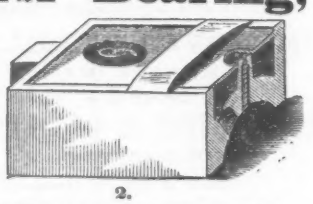


1.



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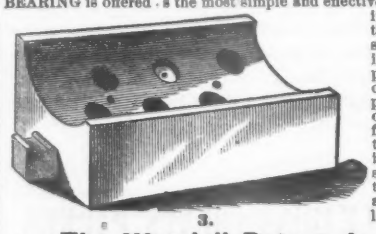

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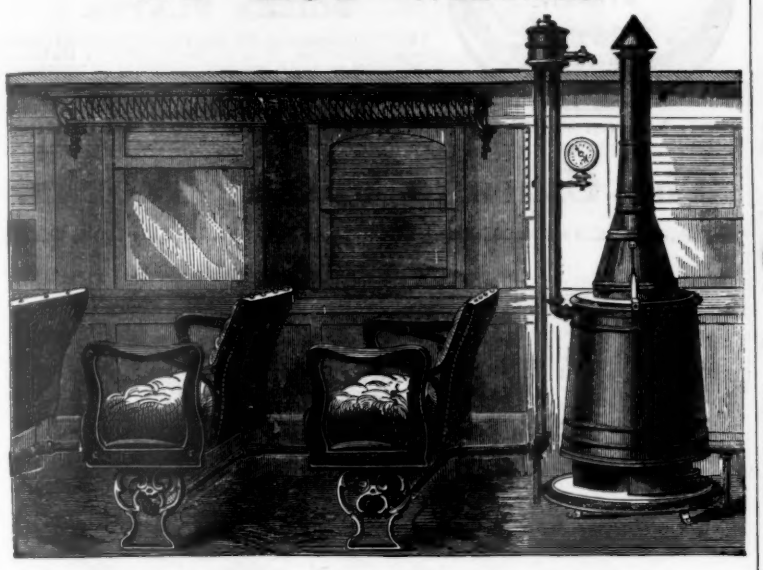

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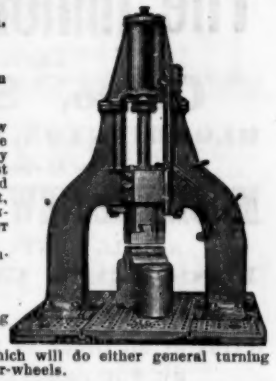

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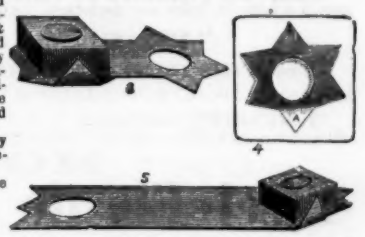

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Demonstrating beyond question its superior working capacity, and great ability to withstand the elements. For RAILROAD LINES, connecting a single wire with a large number of Stations, and for long circuits, this wire is peculiarly adapted; the large conducting capacity secured by the copper, with other advantages, rendering such lines fully serviceable during the heaviest rains.

Having a core of steel, a small number of poles only are required, as compared with iron wire construction, thereby preventing much loss of the current from escape and very materially reducing cost of maintenance OFFICE AMERICAN COMPOUND TELEGRAPH WIRE CO. 234 West 29th Street, New York.

BLISS, TILLOTSON & CO., Western Agents, 247 South Water Street, Chicago.

Charles J. Pusey,

78 & 80 BROADWAY, NEW YORK.

American and English Rails,

LOCOMOTIVES AND CARS FISH-PLATES, SPIKES, &c.

— SOLE AGENT FOR —

Atkins Brothers' Pottsville Rolling Mills, and G. Buchanan & Co., of London.

☞ Special attention given to filling orders for small T and STREET RAILS, of every sight and pattern. P. O. Address—Box 5222.

OLD RAILS BOUGHT OR RE-ROLLED, AS DESIRED.

J. E. FRENCH. W. S. DODGE. D. W. CROSS.

Winslow Car Roofing Company.

PATENT IRON CAR ROOFS.

Established, 1859.

No. 211 Superior St. **CLEVELAND, O.**

Over 20,000 Cars covered with this Roof! We claim that these Roofs will keep Cars dry, and will last as long as the Cars they cover without any extra expense after once put on.

☞ SEND FOR CIRCULARS.

TAYLOR BROTHERS & CO.

CAST STEEL LOCOMOTIVE TYRES,

Best Yorkshire Bar Iron

— AND —

BOILER PLATES.

This Iron is unequaled for strength and durability, soundness and uniformity It is capable of receiving the highest finish, which renders it peculiarly adapted to the manufacture of Locomotive and Gun Parts, Cotton and other Machinery Chain Bolts, &c.

Sole Agency for the United States and Canadas.

The Chicago Spring Works.

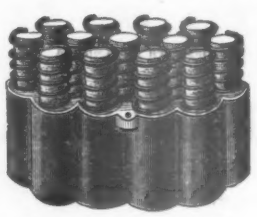
McGREGOR, ATKINSON & CO., Proprietors. OFFICE: No. 128 Lake Street, Chicago.

MANUFACTURERS OF

EXTRA TEMPERED LIGHT ELLIPTIC CAST STEEL SPRINGS AND THE "DANIELS" PAT. CAR SPRING.

Union Car Spring Mf'g Co.

Sole Proprietors of the



Wool-Packed Spiral.

Hebbard.

HEBBARD CAR SPRING!

Offices: No. 4 Dey St., New York, and 19 Wells St., Chicago.

FACTORIES: JERSEY CITY, N. J., and SPRINGFIELD, MASS.

Vose, Dinsmore & Co.,

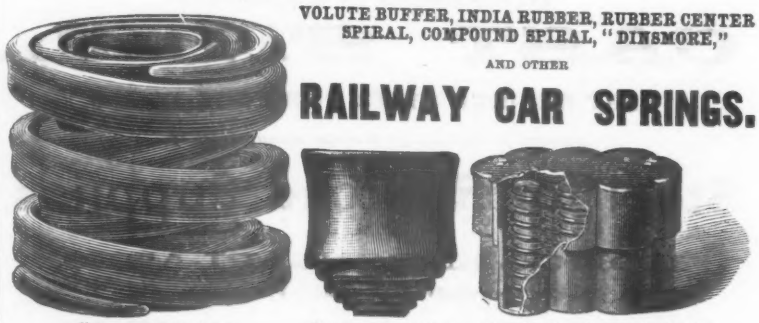
NATIONAL SPRING WORKS,

MANUFACTURERS OF

VOLUTE BUFFER, INDIA RUBBER, RUBBER CENTER SPIRAL, COMPOUND SPIRAL, "DINSMORE,"

AND OTHER

RAILWAY CAR SPRINGS.



"Dinsmore" Spring. Volute Buffer Spring. Group Rubber Center Spiral Spring.

No. 1 Barclay St., NEW YORK. | No. 15 La Salle St., CHICAGO.

WORKS ON 129th AND 130th STREETS, NEW YORK.

GEO. WESTINGHOUSE, Jr., Pres. ROBERT PITCAIRN, Treas. RALPH BAGALEY, Secretary

Westinghouse Air Brake Company,

OF PITTSBURGH. Incorporated by the State of Pennsylvania, 1869.

MANUFACTURERS OF

THE WESTINGHOUSE AIR BRAKE!

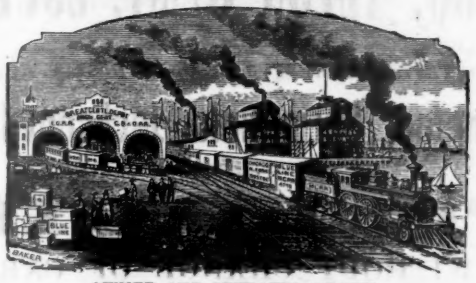
A simple, cheap and effective invention, whereby the entire control of a train of cars is placed in the hands of the Engineer. It is in daily use on a number of the leading Railroads, and is recommended by the most prominent railroad mechanics in the country as an actual necessity.

A Trial Train furnished to any Railroad Company, to be paid for only when found satisfactory. Full information furnished on application.

Great Central Route.

"BLUE LINE."

ORGANIZED JANUARY 1, 1867.

1871.  1871.

OWNED AND OPERATED BY THE

Michigan Central, Illinois Central, Chicago, Burlington & Quincy, Chicago & Alton, Great Western (of Canada), New York Central, Hudson River, Boston & Albany, and Providence and Worcester Railroads.

THE "**BLUE LINE**" is the only route that offers to shippers of freight the advantages of an unbroken gauge through from Chicago to the Seaboard, and to all Interior Points on the line of Eastern Connections beyond Suspension Bridge and Buffalo. All Through Freight is then transported between the most distant points of the roads in interest,

WITHOUT CHANGE OF CARS!

The immense freight equipment of all the roads in interest is employed, as occasion requires, for the through service of this Line, and has of late been largely increased. This Line is now prepared to extend facilities for the transit and delivery of all kinds of freight in Quicker Time and in Better Order than ever before.

The Blue Line Cars

are all of a solid, uniform build, thus largely lessening the chances of delay from the use of cars of a mixed construction, and the consequent difficulty of repairs, while remote from their own roads. The Blue Line is operated by the railroad companies who own it, without the intervention of intermediate parties between the Roads or Line and the public.

Trains run through with regularity **IN FOUR OR FIVE DAYS** to and from New York and Boston. Especial care given to the Safe and Quick Transport of Property Liable to Breakage or Injury, and to all **Perishable Freight.**

Claims for overcharges, loss or damage, promptly settled upon their merits. Be particular and direct all shipments to be marked and consigned *via*

"BLUE LINE."

☞ *FREIGHT CONTRACTS* given at the offices of the company in Chicago, New York and Boston.

J. D. HAYES, GEN. MANAGER,.. Detroit.

C. E. NOBLE,..... } 349 Broadway, N. Y.
GEO. E. JARVIS,... }
N. D. MUNSON,.....Quincy, Ill.

P. K. RANDALL, 69 Washington St., Boston.
W. W. STREET,.....91 Lake St., Chicago.
J. JOHNSON,.....Cairo, Ill.

THOS. HOOPS, GEN. FR'T AGT. Michigan Central Railroad, Chicago.
A. WALLINGFORD, AGT. M. C. & G. W. R. R., No. 91 Lake St., Chicago.
N. A. SKINNER, Freight Agent Michigan Central Railroad.

Empire Line.

THE EMPIRE TRANSPORTATION COMPANY'S

Fast Freight Line to the East

—AND—

TO THE COAL AND OIL REGIONS,

Via Michigan Southern, Lake Shore, and Philadelphia & Erie R. R.'s,

WITHOUT TRANSFER!

Office, No. 72 LaSalle Street, Chicago.

GEO. W. RISTINE, Western Superintendent, Cleveland, Ohio.
W. G. Van Demark,..265 Broadway, New York. | E. L. O'Donnell,.....Baltimore, Md.
G. B. McCulloh,....42 South 5th St., Philadelphia. | Wm. F. Smith,.....Erie, Penn
JOHN WHITTAKER, Pier 14 North River, New York.

JOSEPH STOCKTON, Agent, Chicago.

W. T. HANCOCK, Contracting Agent.
WM. F. GRIFFITTS, Jr., Gen. Freight Agent. Philadelphia.

OMNIBUSES

—OF—

EVERY STYLE!

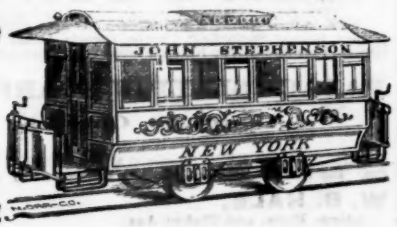
☞ Orders Promptly Filled. ☜

CARS,

LIGHT, STRONG!

—AND—

ELEGANT!



CHICAGO, ROCK ISLAND & PACIFIC RAILROAD.

☞ THE DIRECT ROUTE FOR ☜

JOLIET, MORRIS, OTTAWA, LASALLE, PERU, HENRY, PEORIA,

Lacon, Geneseo, Moline,

ROCK ISLAND, DAVENPORT,

Muscatine, Washington, Iowa City,

GRINNELL, NEWTON, DES MOINES,

COUNCIL BLUFFS & OMAHA!

CONNECTING WITH TRAINS ON THE UNION PACIFIC RAILROAD, FOR

Cheyenne, Denver, Central City, Ogden, Salt Lake, White Pine, Helena, Sacramento, San Francisco,

And Points in Upper and Lower California; and with Ocean Steamers at San Francisco, for all Points in **China, Japan, Sandwich Islands, Oregon and Alaska.**

☞ TRAINS LEAVE their Splendid new Depot, on VanBuren Street, Chicago, as follows:

	LEAVE.	ARRIVE.
PACIFIC EXPRESS, (Sunday excepted)..	10.00 a. m.	4.15 p. m.
PERU ACCOMMODATION, (Sundays excepted).....	4.30 p. m.	9.45 a. m.
PACIFIC EXPRESS, (Saturdays excepted,).....	10.00 p. m.	[Mon. ex. 7.00 a. m.

ELEGANT PALACE SLEEPING COACHES!

Run Through to Peoria and Council Bluffs, Without Change.

☞ Connections at LA SALLE, with Illinois Central Railroad, North and South; at PEORIA, with Peoria, Pekin & Jacksonville Railroad, for Pekin, Virginia, &c.; at PORT BYRON JUNCTION, for Hampton, LeClaire, and Port Byron; at ROCK ISLAND, with Packets North and South on the Mississippi River.

☞ **For Through Tickets,** and all desired information in regard to Rates, Routes, etc., call at the Company's Offices, No. 37 South Clark Street, Chicago, or 257 Broadway, New York.

A. M. SMITH, Gen. Pass. Agent. HUGH RIDDLE, Gen. Supt. P. A. HALL, Asst. Gen. Supt.

KANSAS PACIFIC RAILWAY.

Great Smoky Hill Route

THROUGH **KANSAS** TO **DENVER,** COLORADO,

Connecting with the DENVER PACIFIC R. R. for CHEYENNE; forming, in connection with the UNION and CENTRAL PACIFIC R. R.'s, a NEW ALL-RAIL ROUTE to

Colorado, Wyoming, Utah, Montana,

NEVADA, CALIFORNIA,

AND THE PACIFIC COAST.

THE ONLY ROUTE RUNNING PULLMAN DRAWING-ROOM & SLEEPING CARS THROUGH TO DENVER.

☞ **No Omnibus or Ferry Transfer!** ☜

☞ Direct Connections made in UNION DEPOTS at **Kansas City** [State Line] with the Hannibal & St. Joseph, North Missouri and Missouri Pacific Railroads.

☞ Daily Trains leave Kansas City, State Line and Leavenworth, for Lawrence, Topeka, Emporia, Humboldt, New Chicago, Chetopa, Junction City, Abilene, Salina, Brookville, Ellsworth, Hays, KIT CARSON, DENVER, GREELEY, CHEYENNE, OGDEN, SALT LAKE CITY, CORINNE,

Sacramento & San Francisco.

☞ Connect at Kit Carson with Southern Overland Passenger and Mail Coaches for PUEBLO, TRINIDAD, SANTA FE, and all principal points in

Old and New Mexico and Arizona.

☞ Connect at DENVER with the Colorado Central Railroad and Fast Concord Coaches, for Golden City, Black Hawk, Central City, Idaho City, Georgetown and Fair Play.

Passenger and Freight Rates as low and conveniences as ample as by any Route.

Ask for Tickets via KANSAS PACIFIC RAILWAY, which can be obtained at all principal ticket offices in the United States.

R. B. GEMMELL, Gen. Ticket Agt. Lawrence, Kansas. | T. F. OAKES, Gen. Freight Agt. Kansas City, Mo. | A. ANDERSON, Gen. Sup't. Lawrence, Kan.

FARMS AND HOMES IN KANSAS.

Five Million Acres of Choice Farming Lands, situated along the line of this Great National Route, at from one to six dollars per acre. For full particulars, apply to
JNO. P. DEVEREUX, Land Commissioner, Lawrence, Kan.

THE ERIE & PACIFIC DISPATCH CO.

Are Authorized Freight Agents.

For information, Contracts, and Bills of Lading, apply at their office, 64 Clark Street, Chicago.

H. H. RAPP, AGT.

Western Union Railroad.

CHICAGO & NORTHWESTERN DEPOT, CHICAGO. | MILWAUKEE & CHICAGO DEPOT, MILWAUKEE.

THE DIRECT ROUTE!

CHICAGO, RACINE & MILWAUKEE,

— TO —

Beloit, Savanna, Clinton, Ft. Byron, Davenport, Mineral Point, Madison, Freeport, Fulton, Lyons, Rock Island, Sabula, Galena, Dubuque, Des Moines, Council Bluffs,

OMAHA, SAN FRANCISCO

AND ALL PRINCIPAL POINTS IN

Southern and Central Wisconsin, Northern Illinois, and Central and Northern Iowa.

FRED. WILD, Gen. Ticket Agent.

D. A. OLIN, Gen. Superintendent.

THE FAVORITE THROUGH PASSENGER ROUTE!

Chicago, Burlington & Quincy
RAILROAD LINE.

3 THROUGH EXPRESS TRAINS DAILY!

FROM CHICAGO	Hours.	1st Class Fare.	FROM CHICAGO	Days.	1st Class Fare.
TO OMAHA, - - -	23	$20.00	TO DENVER, - -	2½	$63.00
" ST. JOSEPH, - -	21	19.50	" SACRAMENTO, -	4½	118.00
" KANSAS CITY, -	22	20.00	" SAN FRANCISCO,	5	118.00

TRAINS LEAVE CHICAGO from the Great Central Depot, foot of Lake Street, as follows:

BURLINGTON, KEOKUK, COUNCIL BLUFFS & OMAHA LINE

7:40 A. M. MAIL AND EXPRESS, (Except Sunday,) stopping at all stations; making close connections at Mendota with Illinois Central for Amboy, Dixon, Freeport, Galena, Dunleith, Dubuque, LaSalle, El Paso, Bloomington, &c.

10:45 A. M. PACIFIC FAST LINE, (Except Sunday,) stopping at Riverside, Hinsdale, Aurora, Leland, Mendota, Princeton, Buda, Kewanee, Galva, Galesburg, and all stations West and South of Galesburg.
☞ ELEGANT DAY COACHES and PULLMAN PALACE DRAWING ROOM CARS are attached to this train daily from Chicago

TO COUNCIL BLUFFS & OMAHA WITHOUT CHANGE!

9.00 P. M. PACIFIC NIGHT EXPRESS, (Daily, except Saturday,) for Burlington, Ottumwa, DesMoines, Nebraska City, Council Bluffs, Omaha, and all points West. **Pullman Drawing Room Sleeping Car** attached to this Train daily from **Chicago to Burlington,** and Elegant Day Coaches, from **Chicago to Council Bluffs and Omaha, without change!** This is the Route between

CHICAGO, COUNCIL BLUFFS & OMAHA,

—RUNNING THE CELEBRATED—

Pullman Palace Dining Cars!

49 MILES THE SHORTEST ROUTE BETWEEN

Chicago & Keokuk,

And the Only Route Without Ferrying the Mississippi River!

QUINCY, ST. JOSEPH, LEAVENW'TH & KANSAS CITY LINE.

7.40 A. M. MAIL AND EXPRESS (Except Sunday,) stopping at all stations between Chicago and Galesburg; making close connections at Mendota with Illinois Central for Amboy, Dixon, Freeport, Dunleith, Dubuque, La Salle, El Paso, Bloomington, &c.

10:45 A. M. PACIFIC EXPRESS, (Daily, except Sunday,) with ELEGANT DAY COACHES and PULLMAN'S PALACE SLEEPING CARS attached, running through from Chicago to KANSAS CITY, **Without Change!**

9:00 P. M. PACIFIC NIGHT EXPRESS, (Daily,) with **Pullman Palace Drawing Room Sleeping Car** attached running through from Chicago to QUINCY,

Kansas City, Lawrence, Topeka and Denver,

☞ WITHOUT CHANGE! ☜

64 MILES THE SHORTEST AND ONLY ROUTE BETWEEN

Chicago and Kansas City!

WITHOUT CHANGE OF CARS OR FERRY.

115 MILES The Shortest Route bet. Chicago & St. Joseph.

THE SHORTEST, BEST AND QUICKEST ROUTE BETWEEN CHICAGO AND

Atchison, Weston, Leavenworth, Lawrence,

AND ALL POINTS ON THE KANSAS PACIFIC R'Y.

Local Trains Leave { RIVERSIDE & HINSDALE ACCOMMODATION.7:00 A. M. 1:30 & 6:15 P.M
GALESBURG PASSENGER.....3:00 P. M.
MENDOTA PASSENGER.....4:15 P. M.
AURORA PASSENGER.....5:30 P. M.

Ask for Tickets via Chicago, Burlington & Quincy Railroad, which can be obtained at all principal offices of connecting roads, at Company's office, 63 Clark Street, and at Great Central Depot, Chicago at as low rates as by any other route.

ROB'T HARRIS, Gen'l Superintendent, CHICAGO.
SAM'L POWELL, Gen'l Ticket Agent, CHICAGO.
E. A. PARKER, Gen. West. Pass. Agt., CHICAGO.

THE GREAT THROUGH PASSENGER ROUTE TO KANSAS

IS VIA THE OLD RELIABLE

HANNIBAL & ST. JOSEPH
SHORT LINE.

Crossing the Mississippi at Quincy and the Missouri at Kansas City on New Iron Bridges; running Three Daily Express Trains, Through Cars and Pullman Sleeping Palaces from Chicago & Quincy to St. Joseph & Kansas City.

The Advantages gained by this Line over any other Route from Chicago, are:

115 MILES THE SHORTEST!

To St. Joseph, Atchison, Hiawatha, Waterville, Weston, Leavenworth,

64 MILES THE SHORTEST!

To Kansas City, Fort Scott, Lawrence, Ottawa,

Garnett, Iola, Humboldt, Topeka, Burlingame, Emporia, Manhattan, Fort Riley, Junction City, Salina, Ellsworth, Hays, Sheridan, Olathe, Paola, Cherokee Neutral Lands, Baxter Springs, Santa Fe, New Mexico, and all Points on the KANSAS PACIFIC, and MISSOURI RIVER, FT. SCOTT & GULF R. R's, with which we connect at Kansas City Union Depot.

THIS BEING THE SHORTEST LINE AND QUICKEST, is consequently the cheapest; and no one that is posted thinks of taking any other Route from Chicago to reach principal points in

Missouri, Kansas, Indian Territory, or New Mexico.

DAILY OVERLAND STAGES from west end Kansas Pacific Railway, for Pueblo, Santa Fe, Denver, and points in Colorado and New Mexico.

THIS is also a most desirable Route, via St. Joseph, to Brownsville, Nebraska City, Council Bluffs, and Omaha, connecting with the Union Pacific Railroad for Cheyenne, Denver, Salt Lake, Sacramento, San Francisco, and the Pacific coast.

Through Tickets for Sale at all Ticket Offices. Baggage Checked Through, and Omnibus Transfers and Ferriage avoided.

P. B. GROAT, Gen. Ticket Agent. HANNIBAL, MO
GEO. P. NETTLETON, Gen. Supt. HANNIBAL, MO.

Old, Reliable, Air-Line Route!

CHICAGO, ALTON & ST. LOUIS R. R.

SHORTEST, QUICKEST AND ONLY DIRECT ROAD TO

Bloomington, Springfield, Jacksonville, Alton,

— AND —

ST. LOUIS!

WITHOUT CHANGE OF CARS.

THE ONLY ROAD MAKING IMMEDIATE CONNECTIONS AT ST. LOUIS WITH MORNING AND EVENING TRAINS

—FOR—

ATCHISON, LEAVENWORTH, KANSAS CITY,

Lawrence, Topeka, Memphis, New Orleans,

And All Points South and Southwest.

☞ TRAINS leave CHICAGO from the West-side Union Depot, near Madison Street Bridge. ☜

	Depart.	Arrive.
EXPRESS MAIL	*9:15 A. M.	*8:05 P. M.
JOLIET ACCOMMODATION	*4:00 P. M.	*9:40 A. M.
NIGHT EXPRESS	†5:30 "	*12:50 P. M.
LIGHTNING EXPRESS	‡9:00 "	*7:30 A. M.

*Sundays excepted.
†Daily; Saturdays it runs to Bloomington only.
‡Saturdays and Sundays excepted. Monday mornings this train runs from Bloomington to St. Louis.

This is the ONLY LINE Between CHICAGO & ST. LOUIS RUNNING

Pullman's Palace Sleeping and Celebrated Dining Cars!

BAGGAGE CHECKED THROUGH.

Through Tickets can be had at the Company's office, No. 55 Dearborn street, Chicago, or at the Depot, corner of West Madison and Canal streets, and at all principal Ticket Offices in the United States and Canada. Rates of Fare and Freights as low as by any other Route.

A. NEWMAN, Gen. Pass. Agent. **J. C. McMULLIN, Gen. Supt.**

North Missouri R. R.

PASSENGERS FOR

KANSAS AND THE WEST,

ARE REMINDED THAT

THE NORTH MISSOURI R. R.

—IS—

11 MILES SHORTER than any other Route!

BETWEEN

St. Louis and Kansas City.

15 Miles Shorter between ST. LOUIS and LEAVENWORTH

— AND —

50 MILES SHORTER TO ST. JOSEPH!

THAN ANY OTHER LINE OUT OF ST. LOUIS.

☞ Three Through Express Trains Daily! ☜

Pullman's Celebrated Palace Sleeping Cars on all Night Trains!

☞ FOR TICKETS, apply at all Railroad Ticket Offices, and see that you get your Tickets via St. Louis and North Missouri Railroad.

JAMES CHARLTON, Gen. Pass. and Ticket Agent, St. Louis.
W. R. ARTHUR, General Superintendent, St. Louis.

Pacific Railroad of Missouri.

THE MOST DIRECT AND RELIABLE ROUTE FROM ST. LOUIS THROUGH TO

KANSAS CITY, LEAVENWORTH & ATCHISON,

☞ WITHOUT CHANGE OF CARS! ☜

Close Connections at KANSAS CITY with Missouri Valley, Missouri River, Ft. Scott & Gulf, and Kansas Pacific R'ys, for Weston, St. Joseph, Junction City, Fort Scott, Lawrence, Topeka, Sheridan, Denver, Fort Union, Santa Fe, and

ALL POINTS WEST!

☞ At SEDALIA, WARRENSBURG and PLEASANT HILL, with Stage Lines for Warsew, Quincy, Bolivar, Springfield, Clinton, Osceola, Lamar, Carthage, Granby, Neosho, Baxter Springs, Fort Gibson, Fort Smith, Van Buren, Fayetteville, Bentonville.

PALACE SLEEPING CARS on all NIGHT TRAINS.

Baggage Checked Through Free!

THROUGH TICKETS for sale at all the Principal Railroad Offices in the United States and Canadas. **Be Sure and Get your Tickets over the PACIFIC R. R. OF MISSOURI.**

W. B. HALE, Gen. Pass. and Ticket Agt.
THOS. McKISSOCK. General Superintendent.

ILLINOIS CENTRAL RAILROAD.

PASSENGER TRAINS LEAVE CHICAGO FROM THE GREAT CENTRAL DEPOT, FOOT OF LAKE ST.

ST. LOUIS AND CHICAGO
THROUGH LINE.

No Change of Cars from Chicago to St. Louis.

9:20 A. M. DAY EXPRESS Sundays Ex.
Arriving in ST. LOUIS at 10:30 P. M.

8:15 P. M. FAST LINE. Saturdays Excepted.
Arriving at ST. LOUIS at 8:00 A. M.

AT ST. LOUIS, Direct Connections are Made FOR

Jefferson City, Sedalia, Pleasant Hill, Macon, Kansas City,

LEAVENWORTH, ST. JOSEPH & ATCHISON,

—Connecting at KANSAS CITY for—

LAWRENCE, TOPEKA, JUNCTION CITY, SALINA, SHERIDAN,

Denver and San Francisco!

CAIRO, MEMPHIS AND NEW ORLEANS LINE.

No Change of Cars from Chicago to Cairo.

9:20 A. M. CAIRO MAIL, Sundays Excepted.
Arriving at **Cairo** 2:05 A. M., **Memphis** 12:45 P. M., **Mobile** 9:25 A. M. **Vicksburg** 9:25 A. M., **New Orleans** 11:05 A. M.

8:15 P. M. CAIRO EXPRESS, Except Saturdays.
Arriving at **Cairo** 12:24 P. M., **Memphis** 4:15 A. M., **Little Rock** 7:00 P. M., **Vicksburg** 8:10 P. M., **New Orleans** 1:30 A. M.

4:50 P. M. CHAMPAIGN PASSENGER,
Arriving at **Champaign** at 10:45 P. M.

☞ THIS IS THE ONLY DIRECT ROUTE TO

Humboldt, Corinth, Grand Junction, Little Rock, Hot Springs, Selma, Canton, Grenada, Columbus, Meridian, Enterprise,

MEMPHIS, VICKSBURG, NEW ORLEANS & MOBILE.

At NEW ORLEANS, connections are made for

GALVESTON, INDIANOLA,

And all Parts of Texas.

☞ NOTICE.—This Route is from 100 to 150 MILES SHORTER, and from 12 to 24 HOURS QUICKER than any other.

THIS IS ALSO THE ONLY DIRECT ROUTE TO

DECATUR, TERRE HAUTE, VINCENNES & EVANSVILLE.

Peoria and Keokuk Line.

9:20 A. M. KEOKUK PASSENGER, Sun. Excepted.
Arriving at **Chenoa** 3:20 P. M., **El Paso** 4:08 P. M., **Peoria** 5:43 P. M., **Canton** 7:15 P. M., **Bushnell** 8:37 P. M., **Keokuk** 11:15 P. M., **Warsaw** 11:40 A. M.

Elegant Drawing Room Sleeping Cars

ATTACHED TO ALL NIGHT TRAINS.

Spacious and Fine Saloon Cars!

WITH ALL MODERN IMPROVEMENTS, RUN UPON ALL TRAINS.

BAGGAGE CHECKED THROUGH TO ALL IMPORTANT POINTS.

☞ For Through Tickets, Sleeping Car Berths, Baggage Checks, and information, apply at the office of the Company in the Great Central Depot, foot of Lake St.

Hyde Park and Oakwoods Train.

	LEAVE.	ARRIVE.		LEAVE.	ARRIVE.
HYDE PARK TRAIN,...	*6:20 A. M.	*7.45 A. M.	HYDE PARK TRAIN,...	*2:00 P. M.	*3:15 P. M
HYDE PARK TRAIN...	*8:00 A. M.	*9.20 A. M.	HYDE PARK TRAIN,...	*6:10 P. M.	*7:35 P. M
HYDE PARK TRAIN,..	*12:10 P. M.	*1:45 P. M.			

* Sundays Excepted.

W. P. JOHNSON, Gen. Pass. Agent. M. HUGHITT, Gen. Supt.

CHICAGO & NORTHWESTERN R. W.

Comprising the PRINCIPAL RAILROADS from CHICAGO Directly NORTH NORTH-WEST and WEST.

ALL RAIL TO THE PACIFIC OCEAN!

Great California Line.

TRAINS LEAVE WELLS STREET DEPOT AS FOLLOWS:

8:30 A. M. Clinton Passenger.	**10:00 P. M.** Night Mail.
10:45 A. M. Pacific Express.	**10:00 P. M.** Rock Island Pass.
10:45 A. M. Rock Island Exp.	**4:00 P. M.** Dixon Passenger.

For Sterling, Rock Island, Fulton, Clinton, Cedar Rapids, Boone, Denison, Missouri Valley Junction, Sioux City, Council Bluffs and Omaha, there connecting with the

UNION PACIFIC R. R.

For Cheyenne, Denver, Ogden, Salt Lake, the White Pine Silver Mines, Sacramento, San Francisco, and all parts of Nebraska, Colorado, New Mexico, Arizona, Wyoming, Montana, Idaho, Utah, Nevada, and the PACIFIC COAST.

FROM CHICAGO	Hours.	1st Class Fare.	FROM CHICAGO	Days.	1st Class Fare.
To OMAHA,.....	23	$20.00	To SACRAMENTO,.	4½	$118.00
" DENVER,.....	52	65.00	" SAN FRANCISCO,	5	118.00

TRAINS ARRIVE:—Night Mail, 7.15 a. m.; Dixon Passenger, 11.10 a. m.; Pacific Express 4:15 p. m.; Rock Island Express, 4:15 p. m.; Clinton Passenger, 6:45 p. m.

FREEPORT LINE.

9.00 A. M. & 9.00 P. M. For Belvidere, Rockford, Freeport, Galena, Dunleith, and St. Paul.
4.00 P. M., Rockford Accommodation.
5.30 P. M., Geneva and Elgin Accommodation
6.10 P. M., Lombard Accommodation.
5:50 P. M., Junction Passenger.

TRAINS ARRIVE:—Freeport Passenger, 2:30 p. m., 6:40 a. m.; Rockford Accommodation, 11:10 a. m.; Geneva and Elgin Accommodation, 8:45 a. m.; Junction Passenger, 8:10 a. m.; Lombard Accommodation, 6:50 a. m.

WISCONSIN DIVISION.

☞ Trains leave Depot, cor. West Water and Kinzie Sts., daily, Sundays excepted, as follows:

10.00 A. M. DAY EXPRESS, for Janesville, Monroe, Whitewater, Madison, Prairie du Chien, Watertown, Minnesota Junction, Portage City, Sparta, La Crosse, St. Paul, and ALL POINTS ON THE UPPER MISSISSIPPI RIVER; Ripon, Berlin, Fond du Lac, Oshkosh, Neenah, Appleton, and Green Bay.
3.00 P. M., Janesville Accommodation.
5.00 P. M. NIGHT EXPRESS, for Madison, Prairie du Chien, Watertown, Minnesota Junction, Portage City, Sparta, La Crosse, St. Paul, and ALL POINTS ON THE UPPER MISSISSIPPI RIVER; Ripon, Berlin, Fond du Lac, Oshkosh, Menasha, Appleton, Green Bay, and THE LAKE SUPERIOR COUNTRY.
5.30 P. M., Woodstock Accommodation.

TRAINS ARRIVE:—7:00 a. m., 7:15 p. m., 9:00 a. m., and 2:05 p. m.

MILWAUKEE DIVISION.

MILWAUKEE MAIL,.....	8:15 A. M.
EXPRESS, (ex. Sun.) Waukegan, Kenosha, Racine and Milwaukee,.....	9:45 A. M.
EVANSTON ACCOMMODATION,.....	1:00 P. M.
HIGHLAND PARK PASSENGER,.....	6:20 P. M.
MILWAUKEE ACCOMMODATION, with Sleeping Car attached.....	11:00 P. M.
KENOSHA ACCOMMODATION, (Sundays excepted) from Wells St. Depot.....	4:10 P. M.
AFTERNOON PASSENGER,.....	5:00 P. M.
WAUKEGAN ACCOMMODATION, (except Sundays) from Wells St. Depot.....	5:30 P. M.

TRAINS ARRIVE:—Night Accommodation, with Sleeping Car, 5:00 a. m.; Day Express, 4:15 p. m. Milwaukee Mail, 10:30 a. m.; Afternoon Passenger, 7:40 p. m.; Waukegan Accommodation, 8:25 a. m.; Kenosha Accommodation, 9:10 a. m.; Evanston Accommodation, 3.30 p. m.; Highland Park Passenger, 7.55 p. m.

PULLMAN PALACE CARS ON ALL NIGHT TRAINS.

THROUGH TICKETS Can be purchased at all principal Railroad Offices East and South, and in Chicago at the Southeast corner of Lake and Clark Streets, and at the Passenger Stations as above.

H. P. STANWOOD, Gen. Ticket Agt. **JOHN C. GAULT,** Gen'l Supt.

Milwaukee & St. Paul R. W.

THE ONLY ALL RAIL LINE TO

ST. PAUL AND MINNEAPOLIS!

AND ALL PORTIONS OF

Wisconsin, Minnesota & Northern Iowa.

PURCHASE TICKETS VIA MILWAUKEE.

Passengers Going via Milwaukee,

Have Choice of Seats in Clean Coaches, and on Night Trains, a full night's rest in Palace Sleeping Cars.

☞ BAGGAGE CHECKED THROUGH BY THIS ROUTE ONLY! ☜

PASSENGERS FROM CHICAGO can obtain these Advantages only by he MILWAUKEE DIVISION of the CHICAGO & NORTHWESTERN R'Y.

SPECIAL NOTICE.—Passengers destined to any place in Wisconsin, Minnesota, or Northern Iowa, either on or off the Lines of this Company, who cannot procure Through Tickets to their destination, should purchase their Tickets **TO MILWAUKEE,** as this is the Great Distributing Point for these States.

A. V. H. CARPENTER, Gen. Pass. Agt. Milwaukee. **S. S. MERRILL,** Gen. Manager, Milwaukee.

61 Miles the Shortest Line!

— FROM —

CHICAGO TO NEW YORK.

Pitts., Ft. Wayne & Chicago

— AND —

PENNSYLVANIA CENTRAL

IS THE ONLY ROUTE

Running its Entire Trains THROUGH to Philadelphia and New York, and the only Route running Three Daily Lines of Pullman Day and Sleeping Palaces, from Chicago to

PITTSBURGH, HARRISBURG,

PHILADELPHIA & NEW YORK,

☞ WITHOUT CHANGE! ☜

WITH BUT ONE CHANGE TO

BALTIMORE, PROVIDENCE, NEW HAVEN, HARTFORD, SPRINGFIELD, WORCESTER & BOSTON!

AND THE MOST DIRECT ROUTE TO WASHINGTON.

☞ Trains Leave WEST SIDE UNION DEPOT, corner West Madison and Canal Streets, as follows:

		Mail.	Fast Express.	Pacific Exp.	Night Exp.
Leave—	CHICAGO	5.30 A. M.	9.00 A. M.	5.15 P. M.	9.00 P. M.
Arrive—	PLYMOUTH	9.50 "	12.03 P. M.	8.45 "	12.35 A. M.
"	FORT WAYNE	12.30 P. M.	2.05 "	11.15 "	3.10 "
"	LIMA	3.24 "	4.06 "	1.28 A. M.	5.40 "
"	FOREST	4.43 "	5.08 "	2.45 "	7.07 "
"	CRESTLINE	6.20 "	6.30 "	4.20 "	8.55 "
Leave—	CRESTLINE	6.00 A. M.	6.50 "	4.30 "	9.35 "
Arrive—	MANSFIELD	6.40 "	7.17 "	5.00 "	10.06 "
"	ORRVILLE	9.15 "	9.05 "	6.54 "	11.55 "
"	ALLIANCE	11.10 "	10.40 "	8.30 "	1.30 P. M.
"	PITTSBURGH	3.45 P. M.	1.55 A. M.	12.10 P. M.	4.40 "
"	CRESSON	11.57 "	5.44 "	4.48 "	10.00 "
"	ALTOONA	12.48 A. M.	6.55 "	5.55 "	2.40 A. M.
"	HARRISBURG	5.30 "	11.25 "	10.45 "	2.50 "
"	PHILADELPHIA	6.50 "	3.15 "	3.00 "	6.50 "
"	NEW YORK, VIA PHILADELPHIA	10.30 "	6.30 "	6.41 "	10.30 "
"	NEW YORK, VIA ALLENTOWN	10.30 "	6.30 "	.....	10.30 "
"	BALTIMORE	9.15 P. M.	3.05 "	2.30 A. M.	9.15 P. M.
"	WASHINGTON	1.00 "	5.15 "	5.45 "	1.00 "
"	BOSTON	9.00 "	5.50 A. M.	6.00 "	9.00 "

Boston and New England Passengers will find this Route especially Desirable, as it gives them an opportunity of Seeing the FINEST VIEWS AMONG THE ALLEGHANY MOUNTAINS,

Besides Visiting PITTSBURGH, PHILADELPHIA and NEW YORK, without extra cost!

☞ All New England Passengers holding Through Tickets will be Transferred, with their Baggage, to Rail and Boat Connections in NEW YORK, **Without Charge!**

THROUGH TICKETS for sale at the Company's Offices, at 65 Clark St.; 52 Clark St.; cor. Randolph and LaSalle Sts.; and at Depot, Chicago. Also at Principal Ticket Offices in the West.

CLOSE CONNECTIONS Made at LIMA for all Points on the Dayton & Michigan and the Cincinnati, Hamilton & Dayton Railways, and at CRESTLINE for Cleveland and Columbus.

Express Trains are Equipped with WESTINGHOUSE AIR BRAKES,

The Most Perfect Protection Against Accidents in the World!

F. R. MYERS, Gen. Pass. & Tkt Agt. P. F.W. & C. R'y Chicago. | **W. C. CLELAND,** Gen. Western Pass. Agt. P. F. W. & C. R'y, Chicago.

T. L. KIMBALL, Gen. Western Pass. Agt. Penn. Cen. R. R. Chicago.

Broad Gauge! Double Track!

ERIE RAILWAY.

4 EXPRESS TRAINS DAILY!

From Cleveland, Dunkirk and Buffalo, 625 Miles, to New York, WITHOUT CHANGE of Coaches!

☞ The Trains of this Railway are run in DIRECT CONNECTION WITH ALL WESTERN AND SOUTHERN LINES, for

Elmira, Williamsport, Oswego, Great Bend, Scranton, Newburgh,

NEW YORK, ALBANY, BOSTON, PROVIDENCE,

AND PRINCIPAL NEW ENGLAND CITIES.

New and Improved DRAWING ROOM COACHES are attached to the DAY EXPRESS Running THROUGH TO NEW YORK.

☞ **SLEEPING COACHES,** Combining all Modern Improvements, with perfect Ventilation and the peculiar arrangements for the comfort of Passengers incident to the **BROAD GAUGE,** accompany all night trains to New York.

CONNECTIONS CERTAIN! as Trains on this Railway will, when necessary, **wait from one to two hours for Western trains.**

All Trains of Saturday run directly Through to New York.

☞ **Ask for Tickets via Erie Railway,** which can be procured at 66 Clark Street Chicago, and at all Principal Ticket offices in the West and Southwest.

L. D. RUCKER, Gen'l Superintendent New York. | **A. J. DAY,** Western Passenger Agent, Chicago. | **WM. R. BARR,** Gen'l Passenger Agent, New York.

Pan-Handle

— AND —

Penn'a Central Route East!

☞ SHORTEST AND QUICKEST ROUTE, VIA COLUMBUS, TO ☜

PITTSBURGH, BALTIMORE, PHILADELPHIA & NEW YORK

On and after Sunday, NOVEMBER 27th, 1870, Trains for the East will run as follows:

[DEPOT CORNER CANAL AND KINZIE STS., WEST SIDE.]

7:40 A. M. DAY EXPRESS.

[SUNDAYS EXCEPTED.] Via Richmond. Arriving at

COLUMBUS....	3:00 A. M.	HARRISBURG..	10:35 P. M.	NEW YORK....	6:40 A. M.	WASHINGTON..	5:45 A. M.
PITTSBURGH..	12:15 M.	PHILADELPHIA	3:10 A. M.	BALTIMORE. ..	2:30 A. M.	BOSTON.....	5:05 P. M.

7:10 P. M. NIGHT EXPRESS.

[SUNDAYS EXCEPTED.] Arriving at:

COLUMBUS..	11:15 A. M.	HARRISBURG..	5:20 A. M	NEW YORK...	11:40 A. M.	WASHINGTON.	1:10 P. M.
PITTSBURGH..	7:25 P. M.	PHILADELPHIA.	9.50 A. M.	BALTIMORE...	9:30 A. M.	BOSTON.....	11:50 P. M.

Palace Day and Sleeping Cars

Run Through to COLUMBUS, and from Columbus to NEW YORK, WITHOUT CHANGE!

ONLY ONE CHANGE TO NEW YORK, PHILADELPHIA, OR BALTIMORE!

CINCINNATI & LOUISVILLE AIR LINE SOUTH.

35 Miles the Shortest Route to Cincinnati.

18 Miles the Shortest Route to Indianapolis and Louisville

3 Hours the Quickest Route to Cincinnati!

THE SHORTEST AND BEST ROUTE TO

Columbus, Chillicothe, Hamilton, Dayton, Wheeling, Zanesville, Parkersburg, Marietta, Evansville, Lexington, Terre Haute, Nashville,

ALL POINTS IN CENTRAL & SOUTHERN OHIO, & INDIANA, KENTUCKY & VIRGINIA.

— QUICK, DIRECT AND ONLY ALL RAIL ROUTE TO —

New Orleans, Memphis, Mobile, Vicksburg, Charleston, Savannah,

AND ALL POINTS SOUTH.

Cincinnati, Indianapolis and Louisville Trains run as follows:

THROUGH WITHOUT CHANGE OF CARS!

7.40 A. M. (Sundays excepted) Arriving at		8.05 P. M. (Saturdays excepted.) Arriving at	
LOGANSPORT	1:15 P. M.	LOGANSPORT	1:15 A. M.
KOKOMO	2:32 P. M.	KOKOMO	2:31 A. M.
CINCINNATI	10:10 P. M.	CINCINNATI	9:35 A. M.
INDIANAPOLIS	5:00 P. M.	INDIANAPOLIS	5:40 A. M.
LOUISVILLE	11:30 P. M.	LOUISVILLE	3:50 P. M

Lansing Accommodation: Leaves 3:40 P. M. Arrives 10:55 A. M.

PULLMAN'S PALACE SLEEPING CARS!

Accompany all Night Trains between Chicago and Cincinnati or Indianapolis.

☞ Ask for Tickets **via COLUMBUS** for the East, and **via "The AIR LINE"** for Cincinnati, Indianapolis, Louisville and points South. Tickets for sale and Sleeping Car Berths secured at **95 RANDOLPH STREET, CHICAGO,** and at Principal Ticket Offices in the West and Northwest.

WM. L. O'BRIEN, Gen. Pass. and Ticket Agent, Columbus. | **I. S. HODSDON** Northwestern Pass. Agt. Chicago.

D. W. CALDWELL Gen Supt. Columbus.

The Great Favorite Route for Missouri, Nebraska and Iowa.

KANSAS CITY, ST. JOSEPH

— AND —

COUNCIL BLUFFS

☞ THROUGH LINE! ☜

3 EXPRESS PASSENGER TRAINS Leave Union Depot Daily, on the arrival of Eastern Southern and Western Trains, crossing the Missouri River on the New Iron Bridge at KANSAS CITY, passing the cities of

LEAVENWORTH, ATCHISON, SAINT JOSEPH,

— AND —

NEBRASKA CITY.

Connecting at COUNCIL BLUFFS with Iowa Lines for all prominent points in Iowa, and making DIRECT CONNECTION at **OMAHA** with the Great **Union Pacific Railroad,** for

CHEYENNE, DENVER, SALT LAKE, SACRAMENTO, SAN FRANCISCO

And the Pacific Coast.

Pullman's Palace Sleeping Cars!

ON ALL NIGHT TRAINS.

☞ Ask for Tickets via the People's Favorite Route, **Kansas City, St. Joseph & Council Bluffs Railroad Line.**

A. L. HOPKINS, Gen. Superintendent ST. JOSEPH, Mo. | **A. C. DAWES,** Gen. Passenger Agent, ST. JOSEPH, Mo.

LAKE SHORE
— AND —
MICHIGAN SOUTHERN R.W.

THE GREAT THROUGH LINE BETWEEN

CHICAGO, BUFFALO & NEW YORK,

WITHOUT CHANGE!

AND THE ONLY RAILWAY

RUNNING PALACE COACHES THROUGH!

— BETWEEN —

CHICAGO & NEW YORK, via BUFFALO

☞ WITHOUT TRANSFER OF PASSENGERS! ☜

All Trains Stop at Twenty-Second Street to Take and Leave Passengers. Baggage Checked at that Station for all Points East.

4 EXPRESS TRAINS DAILY, [Sundays Excepted,] Leave CHICAGO from the New Depot, on Van Buren St., at the head of La Salle Street, as follow

5:30 A. M. MAIL TRAIN.
VIA OLD ROAD AND AIR LINE. SUNDAYS EXCEPTED.

Leaves 23d Street 7:45 A. M. Stops at all Stations. **Arrives**—Cleveland, 9:35 P. M.

9:00 A. M. SPECIAL NEW YORK EXPRESS,
VIA AIR LINE. SUNDAYS EXCEPTED.

Leaves—Twenty-Second Street, **9:15 A. M. Arrives**—Elkhart, 12:45 P. M.; Cleveland 9:45 P. M.; Buffalo, 4:10 A. M.; New York, 7:00 P. M.; (Chicago Time) Boston, 11:45 P. M.

This Train has PALACE SLEEPING COACH Attached, Running

THROUGH TO ROCHESTER, WITHOUT CHANGE!

IN DIRECT CONNECTION WITH

Wagner's Celebrated Drawing-Room Coaches on N. Y. Central R. R.

Only Thirty-Three Hours, Chicago to New York!

5:15 P. M. ATLANTIC EXPRESS (Daily),
VIA OLD ROAD.

Leaves—Twenty-Second Street **5:30 P. M. Arrives**—Laporte, 8:10 P. M. (Stops 20 minutes for Supper); arrives at Toledo, 2:50 A. M.; Cleveland, 7:25 A. M. (20 minutes for Breakfast); arrives at Buffalo, 1:50 P. M.; Rochester, 5:10 P. M. (20 minutes for Supper); connects with **Sleeping Coach running Through from Rochester to Boston Without Change,** making but **One Change between Chicago and Boston.**

NEW AND ELEGANT SLEEPING COACH Attached to this Train, Running THROUGH from CHICAGO TO NEW YORK WITHOUT CHANGE! Arrives at NEW YORK, 7:15 A. M.

9:00 P M. NIGHT EXPRESS
VIA AIR LINE. (DAILY EXCEPT SAT. & SUN.)

Leaves—Twenty-Second Street, **9:15 P. M. Arrives**—Toledo, 6:15 A. M. (20 minutes for Breakfast); arrives at Cleveland, 10:50 A. M.; Buffalo, 5:50 P. M.; New York, 12:00 M.; Boston, 3:50 P. M.

KALAMAZOO DIVISION.

Leave Chicago 9:00 A. M. Arrive at Kalamazoo 4:10 P. M.; Grand Rapids, 7:10 P. M.

Leave Chicago 9:00 P. M. Arrive at Kalamazoo 7:25 A. M.; Grand Rapids, 10:15 A. M.

☞ There being no heavy grades to overcome, or mountains to cross, the road bed and track being the smoothest and most perfect of any railway in the United States, this Company run their trains at a high rate of speed with perfect safety.

☞ Travelers who wish to SAVE TIME and make SURE CONNECTIONS, purchase Tickets via

LAKE SHORE & MICHIGAN SOUTHERN R'Y.

THE ONLY LINE RUNNING THROUGH BETWEEN CHICAGO AND BUFFALO, WITHOUT TRANSFER, and in Direct Connection with NEW YORK CENTRAL RAILROAD and ERIE RAILWAY.

General Ticket Office for Chicago, No. 56 Clark Street.

CHAS. F. HATCH,
General Superintendent, CLEVELAND, OHIO

F. E. MORSE,
General Western Passenger Agent, CHICAGO.

GREAT CENTRAL ROUTE!

SPEED! COMFORT! SAFETY!

MICHIGAN CENTRAL
— AND —
Great Western Railways.

THE FAVORITE ROUTE, VIA NIAGARA FALLS, TO

NEW YORK, BOSTON,

AND ALL EASTERN POINTS.

Pullman's Drawing-Room Cars

FROM CHICAGO TO NEW YORK WITHOUT CHANGE.

CELEBRATED HOTEL CARS FROM CHICAGO TO ROCHESTER.

Passenger Trains leave Chicago from Depot, foot of Lake Street, as follows: (All Trains Stop at Twenty-Second Street Station to receive and leave Passengers.)

5:40 A. M. MAIL TRAIN, Sundays Excepted.
Has a car attached from Chicago going over both Main Line and Air Line Division, Without Change. Connect at New Buffalo for St. Joseph; at Kalamazoo for Grand Rapids, Muskegon and Whitehall; at Jackson for Lansing, Saginaw and Bay City.

9:00 A. M. NEW YORK EXPRESS.
(SUNDAYS EXCEPTED.) Arrives at Michigan City at 11:10 A. M.; Niles, 12:20 P. M. [Dinner]; Kalamazoo, 2:10 P. M.; Marshall, 3:34 P. M.; Jackson, 4:30 P. M.; Detroit, 6:55 P. M. [Supper]; London, 11:25 A. M.; Hamilton, 2:35 A. M.; Niagara Falls, 4: A. M.; Rochester, 7:10 A. M. [Breakfast]; Albany, 2:00 P. M.; NEW YORK, **7:00 P. M.**; Springfield, 7:40 P. M.; BOSTON, **11:45 P. M.** This Train connects at ROCHESTER with

WAGNER' DRAWING-ROOM CAR THROUGH

To New York City Without Change!

9:30 A. M. CINCINNATI & LOUISVILLE EXPRESS
(SUNDAYS EXCEPTED.) **Through Cars to Indianapolis and Cincinnati without Change.**

4:10 P. M. Kalamazoo, St. Joseph and Three Rivers Accom.
(SUNDAYS EXCEPTED.) Arrives at New Buffalo at 7:05 P. M.; St. Joseph, 8:40 P. M.; Kalamazoo, 1:05 P. M.; Three Rivers, 10:00 P. M.

5:15 P. M. ATLANTIC EXPRESS.
Leaves Daily. ☞ Arrives at Michigan City at 7:18 P. M.; Niles, 8:30 P. M. [Supper]; Kalamazoo, 10:40 P. M.; Jackson, 1:10 A. M.; Detroit, 3:45 A. M.; London, 8:35 A. M. [Breakfast]; Hamilton, 11:40 A. M.; Niagara Falls, 1:30 P. M.; Buffalo, 3:20 P. M.; Rochester, 5:10 P. M.; Albany, 1:30 A. M.; NEW YORK, **6:40 A. M.**; Springfield, 6:40 A. M.; BOSTON **11:00 A. M.** A MAGNIFICENT

PULLMAN DRAWING-ROOM SLEEPING CAR

IS ATTACHED TO THIS TRAIN DAILY, FROM

CHICAGO TO NEW YORK CITY.

☞ The Celebrated **HOTEL CAR** is also Attached to this Train from **CHICAGO** to **ROCHESTER.**

☞ **SPECIAL NOTICE.**—Boston and New England Passengers will please notice that thi Train now makes a direct connection through. A **Sleeping Car** is attached at Rochester at 5:30 P. M., running through to Springfield, Mass., thus avoiding transfer at Albany. Breakfast at Springfield. This Train reaches Springfield early enough second morning to CONNECT WITH ALL TRAINS up and down the Connecticut

6:05 P. M. CINCINNATI & LOUISVILLE EXPRESS
(SATURDAYS EXCEPTED.) **Through Sleeping Cars to Louisville without Change.**

This is the Only Line Running Sleeping Cars to Louisville!

9:00 P. M. NIGHT EXPRESS. Saturdays and Sundays Excepted.
☞ Arrives at Michigan City at 11:03 P. M.; Niles, 12:25 A. M.; Kalamazoo, 2:00; Marshall, 3:12; Jackson, 4:25; Grand Trunk Junction, 7:00; Detroit, 7:45; London, 1:45 P. M.; Hamilton, 4:35; Toronto, 9:35; Niagara Falls, 5:40; Buffalo, 7:15 P. M.; Rochester, 9:10; Syracuse, 12:25 A. M.; Rome, 1:55; Utica, 2:25; Albany, 6:30 A. M.; NEW YORK, **12:00 M.**; BOSTON, **3:30 P. M.**

A PULLMAN PALACE SLEEPING CAR

Is attached to this Train for **DETROIT.** This Train connects at **DETROIT JUNCTION** with **Grand Trunk Railway** for

MONTREAL, OGDENSBURG, &c.

9:00 P. M. Grand Rapids Express.
(SATURDAYS AND SUNDAYS EXCEPTED.) Arrives at Grand Rapids at 9:50 A. M.

An Elegant Pullman Sleeping Car

IS ATTACHED TO THIS TRAIN

THROUGH TO GRAND RAPIDS WITHOUT CHANGE!

Connecting there Direct to MUSKEGON, WHITEHALL, &c., &c.,

SPECIAL NOTICE.—The GREAT WESTERN RAILWAY of Canada have, during the past summer, put down 140 miles of New Rail, (a large proportion of the same being Steel Rails,) and otherwise improved their track, so that it can be truly said that it is in as good condition as any Line in the country.

☞ **Through Tickets** (and secured accommodations in Drawing-Room Sleeping Cars) can be purchased in Chicago at **60** Clark street (under Sherman House); at **48** Clark street (Grand Trunk Railway); at **53** Clark street (N. Y. C. R. R.); at office under Briggs House; at Great Central Depot, and at

General Office in Tremont House Block.

H. E. SARGENT,
Gen. Sup't M. C. R. R.

W. K. MUIR,
Gen. Sup't Gt. W. Ry.

HENRY C. WENTWORTH,
Gen. West. Pass. Agt. M. C. & Gt. W. Ry.

NOTICES OF THE PRESS.

"Of great interest to railroad men."—[Delaware (O.) Gazette.

"Valuable because of its reliability."—[Holmesburg (Pa.) Gazette.

"A valuable encyclopædia of railway topics."—[The Stockholder.

"The best journal of the class published."—[Philadelphia Herald.

"An excellent journal for railroad men."—[Mankato (Minn.) Record.

"The best paper of the kind now extant."—[Omcial Railway News.

"Promising much for the future."—[Detroit Commercial Advertiser.

"A model of what a railroad newspaper should be."—[Chicago Tribune.

"The best journal of its class in the United States."—[LaCrosse Leader.

"We regard it as the best railroad paper out."—[Peoria National Democrat.

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"Well worthy the patronage of all intelligent railroad men."—[Kalamazoo Gazette.

"A well-edited paper, showing industry and intelligence."—[American Railway Times.

"The best informed railway newspaper published in the West."—[Aurora (Ill.) Beacon.

"Unquestionably the best railroad journal in the United States.—[Waukegan (Ill.) Patriot.

"Standing in the front ranks of railroad journals."—[Snow's Pathfinder Railway Guide.

"Makes a very handsome appearance and is full of valuable matter."—[Chicago Evening Post.

"An impartial and independent journal, valuable to every railroad man."—[Parkersburg (W. Va.) Times.

"Of great interest to railroad men, and almost equally so to those who use railroads."—[Marshall (Mich) Statesman.

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"All who desire to keep themselves posted on the subjects connected with railroads will take it."—[Milwaukee Wisconsin.

"One of the best conducted and most interesting railway journals published in this country."—[New Haven Railway Courant.

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101 Washington St., Chicago

"Has always been one of the best papers of the country for railroad intelligence."—[New York Commercial and Financial Chronicle.

"Has always been one of the most valuable publications in the West * * * Is bound to continue its sway as the leading railroad journal of the country.—[Sedalia (Mo.) Bazoo.

"In its financial and commercial views in connection with the railroad interests of the country, may be regarded as one of the first papers of the United States."—[Pensacola Observer.

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"For railroad men and others wishing to keep themselves thoroughly posted on railroad matters we know of no better paper."—[Madison State Journal.

"One of our most valuable exchanges. * * * Its columns teem with reliable information of great benefit to railroad men of every section of the United States."—[Leavenworth Bulletin.

NOTICES OF THE PRESS.

"In every respect a worthy representative of the energetic and go-ahead city where it is published."—[Cincinnati Railroad Record.

"A most valuable thing to the engineer and all railway men, the capitalist, traveler mechanic and general reader."—[Brooklyn (N. Y.) Argus.

"We know not where its equal can be found. * * * * One of the most valuable journals in the country."—[Evansville (Wis.) Review.

"Full of information, scientific and general, with regard to railroads all over the country, their construction, operation, etc."—[Rochester Chronicle.

"This excellent weekly keeps its readers better posted as to what is going on in the railroad world than any other we have seen."—[Albany (Ga.) News.

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